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SENSITIVITY STUDY OF CFAS AND CFAR OBJECTIVE ANALYSIS TECHNIQUE--ETC(U)

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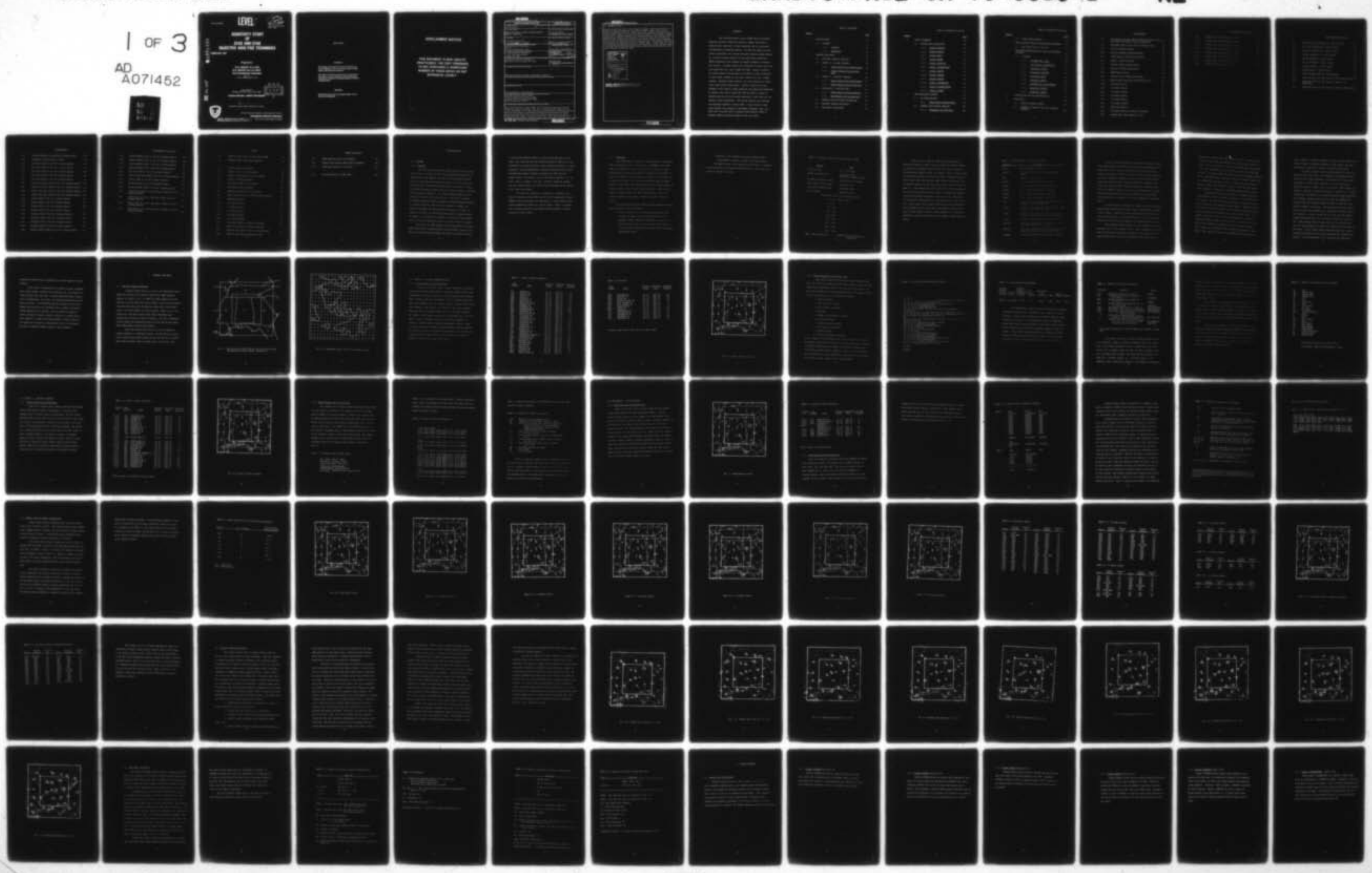

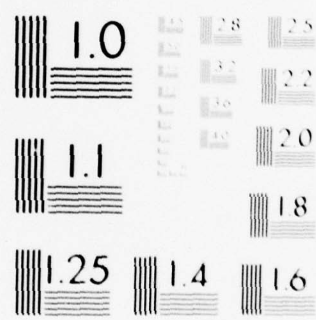

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SENSITIVITY STUDY OF CFAS AND CFAR OBJECTIVE ANALYSIS TECHNIQUES

FEBRUARY 1979

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FINAL REPORT
UNDER CONTRACT DAEA 18-76-C-0060

Contract Monitor: HARRY MAYNARD

Approved for public release; distribution unlimited

US Army Electronics Research and Development Command
Atmospheric Sciences Laboratory
White Sands Missile Range, NM 88002

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The Cloud/Fog Analysis System (CFAS) and the Cloud/Fog Application Routines (CFAR) were applied to weather data bases to determine their sensitivity to control parameters and to type, density, and distribution of observing stations. The data rich region of southeastern United States was selected and hourly aviation weather (Service A), six-hourly synoptic (Service C), and twelve-hourly radiosonde (RAOB) observations were collected for weather scenarios of interest to Army aviation. Computer methods were developed to process these Cont

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20. ABSTRACT (cont)

data and convert them into a form suitable for CFAS. Objective analyses and output displays were generated using CFAS and CFAR, respectively, on such weather variables as sky cover, lowest cloud base, ceiling, visibility, significant present weather, and cloud obscuration to pilot's vision within discrete flight layers. Results, produced from large variations in the computer control parameters and density and distribution of stations, were used to modify the CFAS and CFAR to correct for detected errors and to fix the control parameters so that users are now relieved of that responsibility. This greatly simplifies the knowledge and experience required to execute CFAS. A large number of color-coded displays was generated to demonstrate feasibility, skill, and detail that is possible with an automated meteorological system in providing weather information tailored to Army user needs.

ABSTRACT

The Cloud/Fog Analysis System (CFAS) and the Cloud/Fog Application Routines (CFAR) were applied to weather data bases to determine their sensitivity to control parameters and to type, density, and distribution of observing stations. The data rich region of southeastern United States was selected and hourly aviation weather (Service A), six-hourly synoptic (Service C), and twelve-hourly radiosonde (RAOB) observations were collected for weather scenarios of interest to Army aviation. Computer methods were developed to process these data and convert them into a form suitable for CFAS. Objective analyses and output displays were generated using CFAS and CFAR, respectively, on such weather variables as sky cover, lowest cloud base, ceiling, visibility, significant present weather, and cloud obscuration to pilot's vision within discrete flight layers. Results, produced from large variations in the computer control parameters and density and distribution of stations, were used to modify the CFAS and CFAR to correct for detected errors and to fix the control parameters so that users are now relieved of that responsibility. This greatly simplifies the knowledge and experience required to execute CFAS. A large number of color-coded displays was generated to demonstrate feasibility, skill, and detail that is possible with an automated meteorological system in providing weather information tailored to Army user needs.

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1 INTRODUCTION

1.1 GENERAL

1.1.1 Overview

The Army has more aircraft and pilots than the Air Force, flies most missions in weather sensitive light displacement aircraft at low altitudes over short distances and times, and yet provides the least amount of meteorological training for its pilots. It is not unusual that Army pilots have considerable difficulty and are error prone in reading and properly interpreting weather codes for aviation, synoptic, radiosonde, and pilot report observations. The present standard weather teletype sequences do not make the pilot's job easy. They have to memorize the weather station call letter and numbers, rummage through clip boards to search for particular stations and time changes of weather, and attempt to assimilate the four-dimensional distribution of weather important to his flight. The labor-saving and real-time accurate analyses of weather by a computer based Automatic Meteorological System (AMS) offers considerable potential and value to the Army Aviation Community.

As a part of the AMS program, the Geo-Atmospherics Corporation (GAC) developed the Cloud/Fog Analysis System (CFAS) to take any type and age of meteorological observation and perform an objective analysis

to specify each weather variable on a three-dimensional array of grid points. This cloud-fog data base (CFDB) generated by CFAS can be used individually or its parts analyzed to tailor operational products to a given application. The Geo-Atmospherics Corporation developed several Cloud-Fog Application Routines (CFAR) to interrogate the CFAS data base, extract, analyze, and display a map of each chosen parameter, i.e. sky cover, ceiling, visibility, cloud base, cloud top, significant weather, and cloud amounts within nine different layers extending from the surface to the 3,000 meter altitude.

This study was conducted to determine the sensitivity of the Cloud Fog Analysis System (CFAS) and the Cloud Fog Application Routines (CFAR) to type and distribution of observations, to select suitable CFAS control parameters for routine use, and to perform a series of computer runs on weather scenarios to demonstrate potential benefits of weather automation to Army aviation.

1.1.2 Background

The CFAS/CFAR is a computer software package of several interrelated subprograms coded in the language of FORTRAN V. The CFAS/CFAR was designed to be one of the subsystems of the U.S. Army's Automatic Meteorological System (AMS). The function of the CFAS is to create and maintain a cloud-fog data base (CFDB) in near real-time on a square grid covering a user-specified geographical area relocatable anywhere in the world. The CFAR then utilizes the CFDB to generate on demand, products useful in Army aviation operations. CFAR products currently developed include two-dimensional depictions of areas of critical visibilities on the ground, ceilings, and severe convective activity.

The data sources which the CFAS objectively analyzes and from which the CFDB is generated include:

1. Selected elements from scheduled teletype network transmissions of surface and upper air observations such as AIRWAYS, SYNOP, METAR and RADIOSONDE coded messages.
2. The three-hour prognosis of layered cloud cover produced by the Air Force Global Weather Central's Three Dimensional Nephanalysis Model.

3. Elements of non-scheduled and special weather reports corresponding to elements in either of the above sources.

The CFDB consists of the elements listed in Table 1.1 specified at each grid point in a horizontal window 500 km on a side. The grid points are spaced 25 km apart.

TABLE 1.1 Elements of the Cloud Fog Data Base (CFDB)

Element	Units
Total sky cover	00 - 100 Percent
Height of ceiling layer	dekameters, AGL* (minus if a variable ceiling)
Prevailing visibility at surface	meters (minus if variable)
Base height of lowest cloud	dekameters, AGL
Top height of highest cloud	dekameters, AGL
Present weather	WMO** code 4677

Percent cloud cover in the following layers:

0 - 49	meters,	AGL
50 - 99	"	"
100 - 199	"	"
200 - 299	"	"
300 - 599	"	"
600 - 999	"	"
1000 - 1499	"	"
1500 - 1999	"	"
2000 - 3000	"	"

*AGL - above ground level

**WMO - World Meteorological Organization

Previous work on CFAS and CFAR was directed toward an engineering solution to insure "working" models and computer programs for analyzing and applying cloud/fog data. Under these conditions, refinements were neither possible, nor required. Also, in order to make the work effort tractable, a decision was made to manually input parameters which control the CFAS and CFAR. Those input parameters that are weather dependent and that were varied in this study are listed in Table 1.2. They include such items as the time to begin an analysis, time of the oldest data to be used, number of possible grid squares to search for observations surrounding a grid point, first search square size that will be interrogated (if no observation exists, second, third, etc., search square size), distance between two or more observations to be combined into one "best report", and distance and time scale factor to allow cellular convective cloud information to be extrapolated differently in space and time than the more strataform middle and high clouds.

TABLE 1.2 Weather Related CFAS Input Parameters

Parameter	Description
TIME	Time of analysis, minutes
TYMOLD	Time of oldest data to be used in analysis, minutes
NSSQ	Number of search squares
ISSQ(1)	Size of first search square, grid units
ISSQ(2)	Size of second search square, grid units
ISSQ(3)	Size of third search square, grid units
ISSQ(4)	Size of fourth search square, grid units
ISSQ(5)	Size of fifth search square, grid units
DSP	Maximum distance between observations which are combined into a best report, Km
DIST(1)	Distance scale factor when only convective clouds are present in a best report, Km
DIST(2)	Distance scale factor when only convective and middle clouds are present in a best report, Km
DIST(3)	Distance scale factor for all other cases, Km
TYMC(1)	Time scale factor when only convective clouds are present in a best report, minutes
TYMC(2)	Time scale factor when only convective and middle clouds are present in a best report, minutes
TYMC(3)	Time scale factor for all other cases, minutes

A 500 km square geographical area within the southeast portion of the United States was selected for analysis and demonstration of the CFAS/CFAR. Three reasons for selecting this area are (1) high data density, (2) variety of weather, and (3) location Army aviation school at Fort Rucker, Alabama. Attempts were made to center the grid window symetrically about the Army aviation training bases in Alabama. All routine and aperiodic weather reporting stations were identified within the 500 km analysis window region and for an additional 200 km border surrounding that window to insure data distribution in a manner that allows analyses to be performed on the outer boundaries of the window region.

A weather watch was instituted to search for and select synoptic meteorological conditions that provide sequences and scenarios important to Army aviation. Situations depicting deteriorating flight weather conditions received priority. Particular attention was given to those features effecting sky cover, ceiling, visibility, and significant weather events.

Three different synoptic weather sets were selected for the dates December 6 to 8, 1976, February 25 to 27, 1977, and March 5 to 7, 1977. Data included surface observations of hourly aviation weather and six-hourly synoptic data, and upper air observations from radiosonde and

pilot reports. Each data set was examined closely to eliminate errors, minimize missing data, and maximize the number of data sources and inputs. Care was exercised in decoding the weather data and encoding it in a form compatible with the exact input needs of the CFAS/CFAR programs. This data sample was chosen to provide a technical challenge to the CFAS/CFAR system while at the same time depicting features that are operationally interesting to pilots. Several types and changes of weather scenarios were captured to provide a large total data sample which illustrates a wide range of operational flight weather conditions.

Operational performance and quality of information output from CFAS/CFAR was studied to determine sensitivity to type and density of data sources. Test runs were made using maximum amount of all types of data and using every available reporting station. Results from these runs formed the baseline analysis or ground truth for subsequent analyses where data amount and distribution were systematically varied. A comparative analysis was made to determine degradation as a function of increasing sparsity of data. The data sparsity was created in two ways. The first way consisted of withholding data from selected stations in such a manner as to uniformly reduce the density throughout the entire region. The second way consisted of withholding data from stations in

such a manner as to create a subregion of little or no data (silent area) and thus create a nonuniform distribution of data density. This latter case having a silent area is typical of battlefield environments.

The present manually inputted control parameters of CFAS were altered to effect such things as the mesoscale and synoptic scale distance and time constant parameters, cut-off distances for best reports, and number of search squares allowable to find data necessary to analyze and depict a weather value at a grid point. Three methods were imposed to establish a quantitative measure of "goodness of fit" between "ground truth" and analyses by sequentially changing control parameters. The correlation coefficient and root mean square error (RMSE) were computed where the ensemble included all values at every grid point where an analysis was possible. Those grid points where an analysis was not possible were tabulated and a percentage of missing analyses was computed. A total of 16 test runs was made using all available weather observations while only one control parameter was varied at a time. Three different ranges of values were used for seven distance and time control parameters to bracket the expected mean with high and low values. The five search square control parameters were varied to investigate performance versus computer execution time required for an analysis. A fixed predetermined set of instructions was defined for

operating the CFAS and was incorporated in the final operating computer program.

A time series of observations was selected to depict interesting Army aviation weather scenarios for the Alabama area. The sequence of events proceeds from clear skies to rapidly deteriorating flight weather, such as thunderstorms, low clouds, and visibility restricting fog moving across the region. The CFAS/CFAR computer analyses show the rapid changes that occur from one observation time to another, the detail of weather depiction that is possible, and the principle of displaying weather according to weather categories indicative of weather threat to flight operations. A packet containing highlights of these results was put together for the purpose of demonstrating some of the advantages and value of automated weather analyses to Army operations.

2 WEATHER DATA BASES

2.1 DATA AND ANALYSIS WINDOWS

A square window 900 km on a side in the Southeastern United States was selected as the source of data for the CFAS sensitivity analysis, as shown in Fig. 2.1. While the CFAS program will accept data from any point within this 900 km window, actual grid point analyses occur only within the inner 500 kilometer square whose southwestern corner is 31° north latitude, 89° west longitude. Figure 2.2 is a topographic map of the 500 km inner square where intersecting lines represent the grid points of points of analyses. The state of Alabama is enclosed within and encompasses nearly all of the 500 km inner square where CFAS performs the grid point analyses.

These data windows were chosen due to the variability of weather conditions, or significant weathers, the high density of weather service stations which report regularly and the fact that the Fort Rucker Army Aviation Training Center is located in the center of the square.

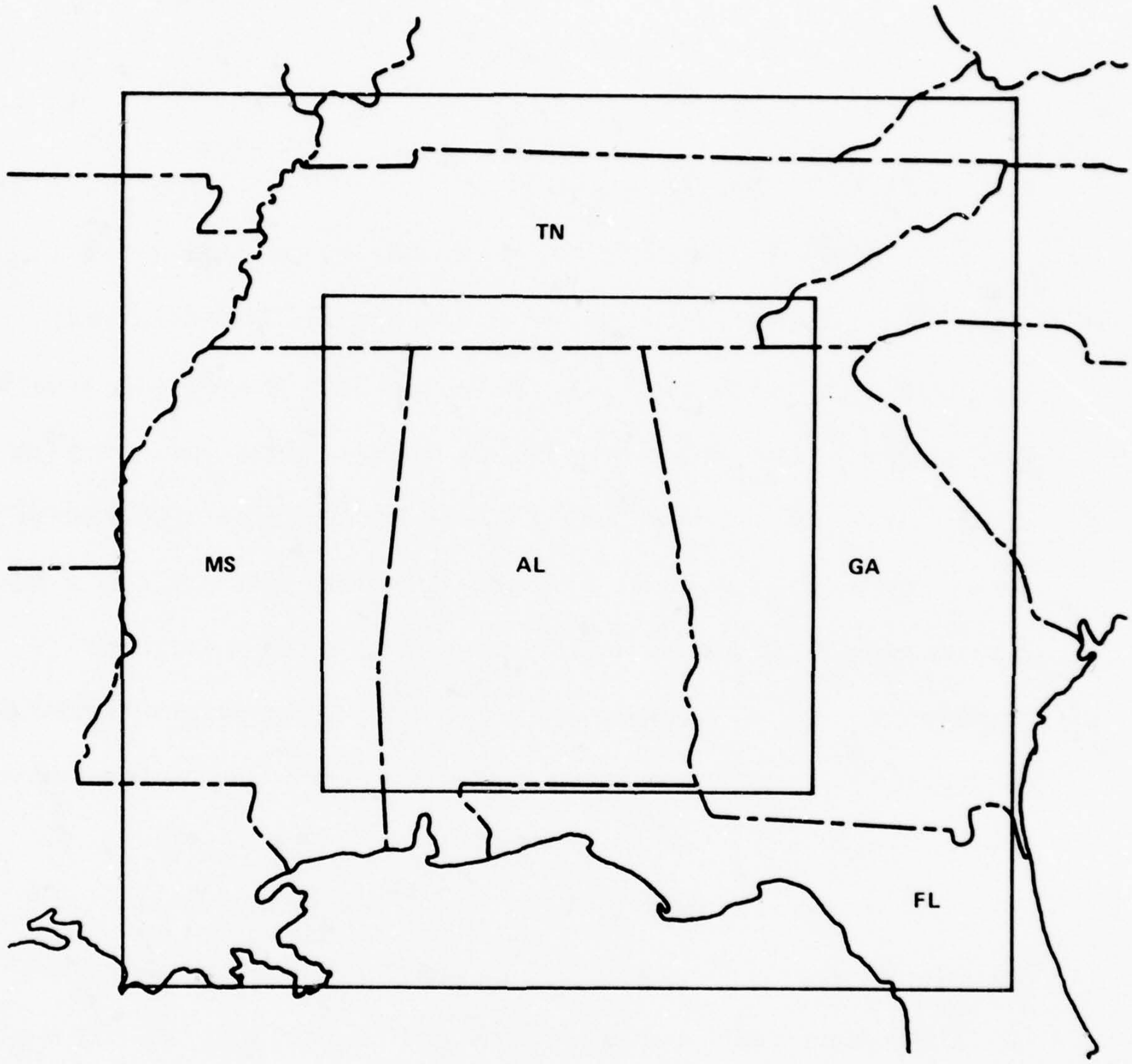

Fig. 2.1 Map Showing the Outer (900 km) and Inner (500 km) Data Acceptance and Analysis Square, Respectively

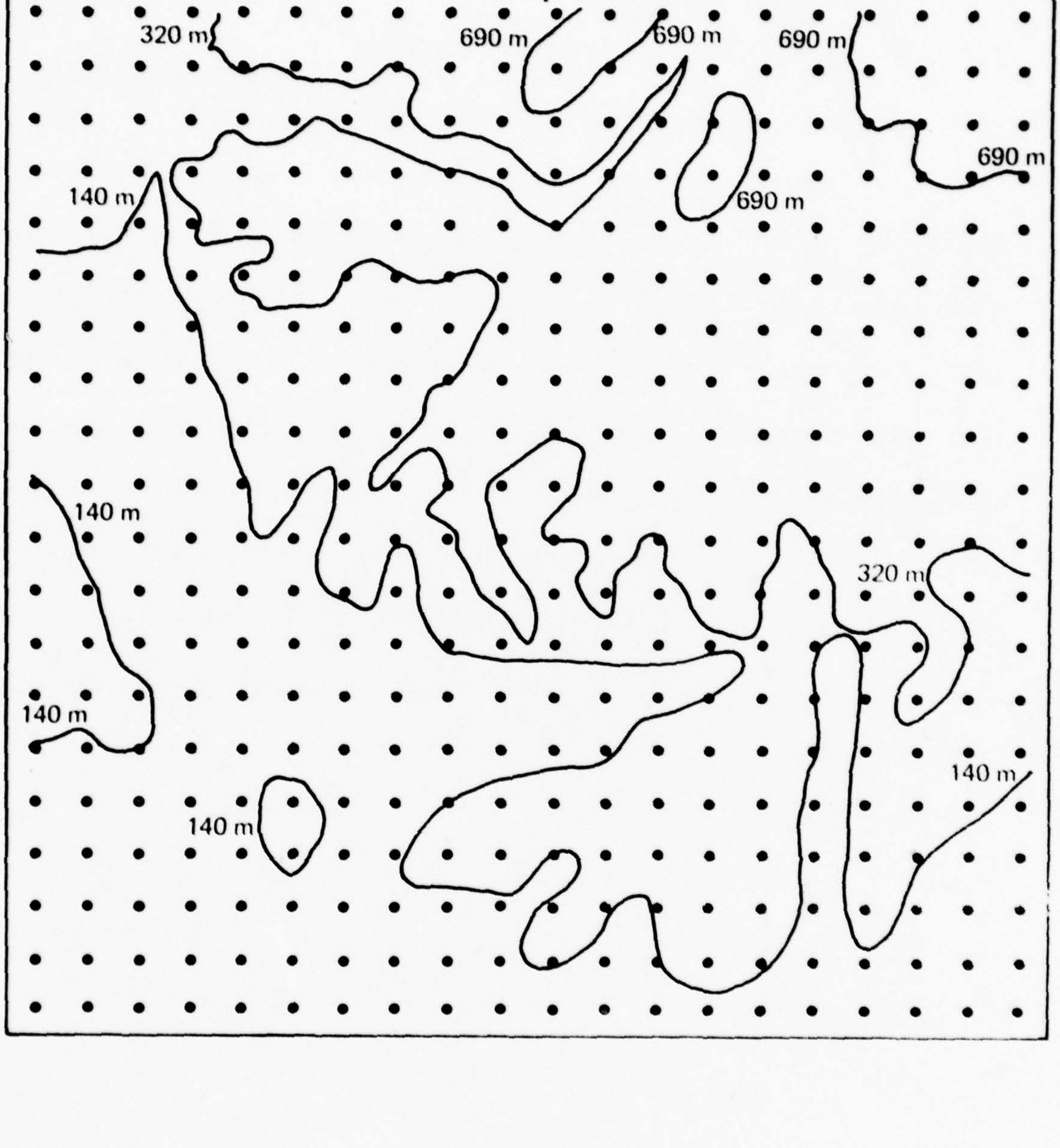

Fig. 2.2 Topograpnic Map of Inner (500 km) Analysis Square

2.2 SERVICE A - HOURLY WEATHER REPORTS

2.2.1 Station Location and Characteristics

There are 45 weather service stations within the 900 kilometer window which transmit hourly (SA) or supplementary (SW) aviation weather observations over teletype service A. Forty-two stations report regularly while 3 stations report very infrequently. These 45 stations report from nine states: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, and Tennessee. The station locations range from 29° to 36° North Latitude and 81° to 90° West Longitude. The altitudes of the stations range from 0 to 805 meters above sea level. Table 2.1 gives a detailed account of each Service A station, its identifier, location, latitude, longitude and altitude in meters. Figure 2.3 shows all Service A stations and their locations within the 900 kilometer window, plotted on a mercator map projection, 1:7, 500,000 scale at latitude 22° 30'. Notice that the Service A stations are uniformly distributed throughout the entire window region.

TABLE 2.1 Service A Station Information

CALL LETTERS	NAME	LATITUDE NORTH	LONGITUDE WEST	ALTITUDE (METERS)
ABY	ALBANY GA	31° 32'	084° 11'	60
AGS	AUGUSTA GA	33° 22'	081° 58'	45
AHN	ATHENS GA	33° 57'	083° 19'	247
AMG	ALMA GA	31° 32'	082° 31'	63
ANB	ANNISTON AL	33° 35'	085° 51'	188
AND	ANDERSON SC	34° 30'	082° 43'	236
AQQ	APALACHICOLA FL	29° 44'	084° 59'	11
ATL	ATLANTA GA	33° 39'	084° 26'	315
AVL	ASHEVILLE NC	35° 26'	082° 32'	661
BHM	BIRMINGHAM AL	33° 34'	086° 45'	192
BNA	NASHVILLE TN	36° 07'	086° 41'	184
BTR	BATON ROUGE LA	30° 32'	091° 09'	23
BVE	BOOTHVILLE LA	29° 20'	089° 24'	0
CEW	CRESTVIEW FL	30° 47'	086° 31'	56
CHA	CHATTANOOGA TN	35° 02'	085° 12'	210
CSG	COLUMBUS GA	32° 31'	084° 56'	120
CSV	CROSSVILLE TN	35° 57'	085° 05'	570
DHN	DOTHAN AL	31° 19'	085° 27'	113
DYR	DEYERSBURG TN	36° 01'	089° 24'	105
FTY	ATLANTA GA	33° 47'	084° 31'	257
GLH	GREENVILLE MS	33° 29'	090° 59'	40
GNV	GAINSVILLE FL	29° 42'	082° 16'	50
GSP	GREENVILLE/SPRTNBG SC	34° 54'	082° 13'	296
GWO	GREENWOOD MS	33° 30'	090° 12'	41
HSV	HUNTSVILLE AL	34° 39'	086° 46'	196
JAN	JACKSON MS	32° 19'	090° 05'	101
JBR	JONESBORO AR	35° 50'	090° 39'	805
MCB	McCOMB MS	31° 16'	090° 28'	143
MCN	MACON GA	32° 42'	083° 39'	110
MEI	MERIDIAN MS	32° 20'	088° 45'	94
MEM	MEMPHIS TN	35° 03'	089° 59'	87
MGM	MONTGOMERY AL	32° 18'	086° 24'	62

TABLE 2.1 (Continued)

CALL LETTERS	NAME	LATITUDE NORTH	LONGITUDE WEST	ALTITUDE (METERS)
MGR	MOULTRIE GA	31° 05'	083° 48'	88
MKL	JACKSON TN	35° 36'	088° 55'	129
MOB	MOBILE AL	30° 41'	088° 15'	67
MSL	MUSCLE SHOALS AL	34° 45'	087° 37'	171
MSY	NEW ORLEANS LA	29° 59'	090° 15'	9
* NEW	NEW ORLEANS LA	30° 02'	090° 02'	3
PNS	PENSACOLA FL	30° 28'	087° 12'	36
* RMG	ROME GA	34° 21'	085° 10'	196
* SPA	SPARTANBURG SC	34° 55'	081° 57'	251
TCL	TUSCALOOSA AL	33° 14'	087° 37'	57
TLH	TALLAHASSEE FL	30° 23'	084° 22'	21
TYS	KNOXVILLE TN	35° 49'	083° 59'	299
VLD	VALDOSTA GA	30° 47'	083° 17'	66

* Stations report never or only once in our data sample

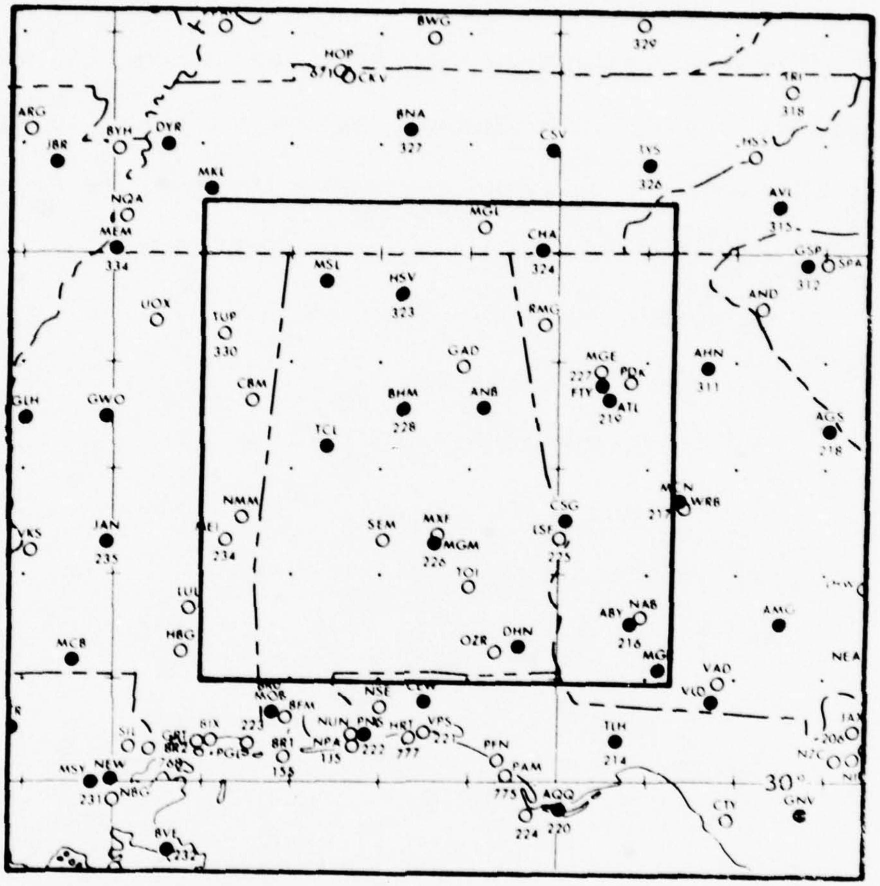

Fig. 2.3 Service A Station Locations

2.2.2 Aviation Weather Code and Data Used

Three types of Service A reports were used to build the data sets. They were the regularly scheduled hourly reports, SA, the irregular reports from supplementary stations, SW, and the special reports, SP, made when warranted by significant weather changes. The format of each of these reports provides for the following information:

1. Station Identifier
2. Type and Time of Report
3. Sky Condition and Ceiling
4. Visibility
5. Weather and Obstruction to Vision
6. Sea Level Pressure
7. Temperature and Dew Point
8. Wind Direction and Speed
9. Altimeter Setting
10. Runway Visual Range or Remarks

For the purposes of the sensitivity study we were concerned only with the station, type and time of report, sky condition and ceiling, visibility and present weather for those elements of the Service A report having some bearing on Army Aviation operations. Figure 2.4 is an example of the actual Service A teletype transmission, while Figure 2.5 is a sample of the coded message separated by information groups.

Figure 2.4 Service A Teletype Transmitted Report

```
SA 071801
AMG                              -   /41/2-/3410/015/000/PNO VV9.+/
FTY 35 SCT E250 BKN 7 42/33/3312/009
ATL 250 SCT 12 180/41/33/3213G22/006→ATL↘1/13 3/1
MCN M6 OVC 5F 175/50/49/3111/005
CSG E40 BKN 12 191/47/43/3207/010
ABY SP M7 BKN 12 OVC 7 50/50/3210/006/RB22E24→ABY↘2/7
AMG→AMG↘3/7
SAV 1 SCT M5 OVC 11/2R-L-F 143/53/43/3208/994/RB30→SAV↘11/14 3/3 3/7
SSI SP 4 SCT M7 BKN 15 OVC 2L-F 139/53/53/3406/994→SSI↘11/18
VLD SP M4 OVC 7R- 56/56/3208/002/CIG RGD
MGR
TLH SP M8 OVC 5R-F 179/57/56/3306/006/CIG RGD R- INTMT [illegible]
→TLH↘1/9 2/15 3/6
JAX M15 BKN 7 139/71/67/2308/994 →JAX↘1/2
GNV M5 OVC 7 154/70/67/2410/999
MCO CLR 4H 164/67/65/2007/001→MCO↘2/1
ORL CLR 4H /1906/001
MLB SP M5 BKN 5F 69/69/2308/002
TIX FINO→TIX↘1/1
VRB SP W0X 0F 169/72/71/2206/003
PIE S W1X1F 69/68/2008/003/R17LVV1
SRQ CLR 7 70/64/1805/004→SRQ↘3/1
FMY W2X 7/5F 176/66/66/2008/005→FMY↘2/11 2/12
FLL -X E2 BKN 2F 71/66/0000/006
MIA -X 6 SCT 2F 187/73/70/0000/008/F4→MIA↘1/6
EYW CLR 12 179/75/69/1603/006→EYW↘1/5

MISSING

MISSING
```

Figure 2.5 Coded Service A Transmission

Location Identifier and Type of Report	Sky and Ceiling	Visibility, Weather, & Obstruction to Vision	Sea Level Pressure	Temperature and Dew Point	Wind	Altimeter Setting	Remarks
CEW SP	-X E3 OVC	1/2 RF	123	/65/62	/2006	/990/	RB 30

The CFAS program searches for the most current and significant information, making the time, information content, and type of report important. A special report indicated by the letters SP after the station designator as in Figure 2.5, is weighed more heavily by CFAS than a regular hourly Service A report because it is the most current report and because Specials occur only when a significant change in weather has occurred. In the Service A transmission the sky condition and ceiling information follows the location and type of report. The sky condition is reported by one of seven sky cover designators given in Table 2.2.

TABLE 2.2 Summary of Sky Cover Designators

Designator	Meaning	Spoken
CLR	Clear (Less than 0.1 sky cover)	CLEAR
SCT	Scattered Layer Aloft (0.1 through 0.5 sky cover)	SCATTERED
BKN*	Broken Layer Aloft (0.6 through 0.9 sky cover)	BROKEN
OVC*	Overcast Layer Aloft (More than 0.9, or 1.0 sky cover)	OVERCAST
-SCT	Thin Scattered — At least 1/2 of the sky cover aloft is transparent at and below the level of the layer aloft	THIN SCATTERED
-BKN	Thin Broken — At least 1/2 of the sky cover aloft is transparent at and below the level of the layer aloft	THIN BROKEN
-OVC	Thin Overcast — At least 1/2 of the sky cover aloft is transparent at and below the level of the layer aloft	THIN OVERCAST
X*	Surface Based Obstruction (All of sky is hidden by surfaced based phenomena)	SKY OBSCURED
-Y	Surface Based Partial Obscuration (0.1 or more, but not all, of sky is hidden by surface based phenomena)	SKY PARTIALLY OBSCURED

* Sky condition represented by this designator may constitute a ceiling layer

The height of the base of a layer of clouds precedes the sky cover designator. Height is reported in hundreds of feet above ground level. If the station designator is CLR, no height will be given since no sky cover is reported. When more than one layer is reported, layers are in ascending order of height. The height may be preceded by the letter "M" - measured ceilings, "E" - estimated ceiling, or "W" indefinite ceiling, meaning that regardless of the method of determination,

vertical visibility is classified as an indefinite ceiling. The ceiling designators are significant to CFAS as it searches for and weighs more heavily the information presumed to be most reliable. The measured height would therefore be more significant than either the estimated or the indefinite ceiling.

The visibility at the observation site immediately follows the sky condition and ceiling report. Visibility is the greatest distance objects can be seen and identified through at least 180° of the horizon. It is reported in statute miles and fractions. Visibility is important to CFAS as are cloud layers or any other factor affecting the pilots ability to see.

Weather and obstructions to vision when occurring at the station are reported immediately following visibility. The term weather refers to those items listed in Table 2.3 rather than to the more general meaning of all atmospheric phenomena. Weather is significant with regard to visibility as well as flying conditions, and therefore is important in the CFAS sensitivity analysis.

TABLE 2.3 Weather and Obstruction to Vision Symbols

A	Hail
BD	Blowing Dust
BN	Blowing Sand
BS	Blowing Snow
D	Dust
F	Fog
GF	Ground Fog
H	Haze
IC	Ice Crystals
IF	Ice Fog
IP	Ice Pellets
IPW	Ice Pellet Showers
K	Smoke
L	Drizzle
R	Rain
RW	Rain Showers
S	Snow
SG	Snow Grains
SP	Snow Pellets
SW	Snow Showers
T	Thunderstorm
T+	Severe Thunderstorm
ZL	Freezing Drizzle
ZR	Freezing Rain

Precipitation intensities are indicated thus:

--Very Light; -Light; (no sign) Moderate; + Heavy

2.3 SERVICE C - SYNOPTIC WEATHER

2.3.1 Station Location and Characteristics

There are 27 weather service stations within the 900 kilometer window which transmit Service C observations, 17 stations report regularly while 10 stations report very infrequently. All those stations reporting Service C also report Service A and report from the same states as Service A, except Arkansas. Again the station locations range from 29^o to 36^o North Latitude and 81^o to 90^o West Longitude. The altitudes of the stations range from 0 to 661 meters above sea level. Table 2.4 gives a detailed account of each Service C station, its identifier, location, latitude, longitude and altitude in meters. Figure 2.6 shows all Service C stations and their locations within the 900 kilometer window. Notice that in addition to being fewer in number, Service C stations are not as uniformly distributed as the Service A stations.

TABLE 2.4 Service C Station Information

STATION #	CALL LETTERS	NAME	LATITUDE NORTH	LONGITUDE WEST	ALTITUDE (METERS)
*72213	AYS	WAYCROSS GA	31° 15'	082° 24'	46
72214	TLH	TALLAHASSEE FL	30° 23'	084° 22'	21
*72216	ABY	ALBANY GA	31° 32'	084° 11'	60
72217	MCN	MACON GA	32° 42'	083° 39'	110
72218	AGS	AUGUSTA GA	33° 22'	081° 58'	45
72219	ATL	ATLANTA GA	33° 39'	084° 26'	315
*72220	AQQ	APALACHICOLA FL	29° 44'	084° 59'	11
*72221	VPS	ELGIN AFB FL	30° 29'	086° 31'	29
*72222	PNS	PENSACOLA FL	30° 28'	087° 12'	36
72223	MOB	MOBILE AL	30° 41'	088° 15'	67
*72224					
72226	MGM	MONTGOMERY AL	32° 18'	086° 24'	62
*72227					
72228	BHM	BIRMINGHAM AL	33° 34'	086° 45'	192
72231	MSY	NEW ORLEANS LA	29° 59'	090° 15'	9
*72232	BVE	BOOTHVILLE LA	29° 20'	089° 24'	0
72234	MEI	MERIDIAN MS	32° 20'	088° 45'	94
72235	JAN	JACKSON MS	32° 19'	090° 05'	101
72311	AHN	ATHENS GA	33° 57'	083° 19'	247
72312	GSP	GREENVILLE/SPRTNBRG SC	34° 54'	082° 13'	296
*72313	SPA	SPARTANBURG SC	34° 55'	081° 57'	251
72315	AVL	ASHEVILLE NC	35° 26'	082° 32'	661
*72323	HSV	HUNTSVILLE AL	34° 39'	086° 46'	196
72324	CHA	CHATTANOOGA TN	35° 02'	085° 12'	210
72326	TYS	KNOXVILLE TN	35° 49'	083° 59'	299
72327	BNA	NASHVILLE TN	36° 07'	086° 41'	184
72334	MEM	MEMPHIS TN	35° 03'	089° 59'	87

* Those stations not reporting in our data sample

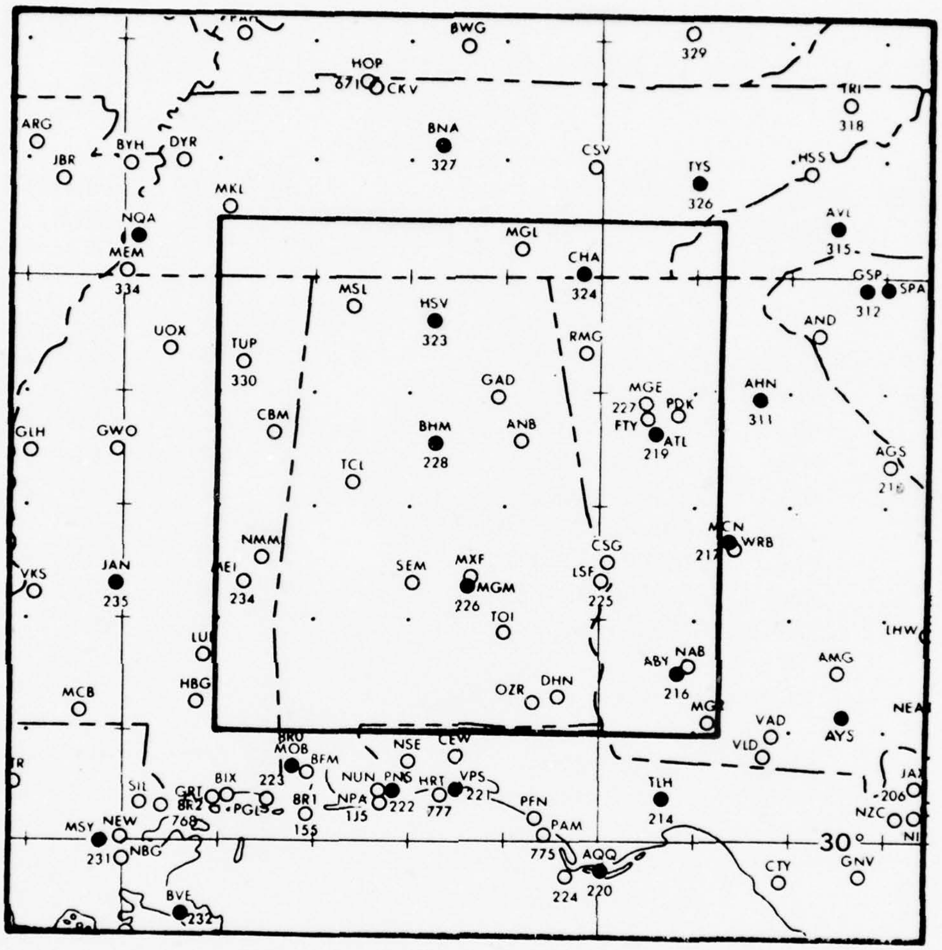

Fig. 2.6 Service C Station Locations

2.3.2 SYNOP Weather Code and Data Used

The complete form of surface synoptic report used in the CFAS sensitivity study is referred to as the primary synoptic, the 6-hourly report or SYNOP. The primary synoptic is reported at the standard hours of observation which are 0000, 0600, 1200, 1800 GMT. The reports are divided into the universal group and the supplementary group. The first seven or eight groups of the SYNOP code, IIiii through $6P_oP_oP_oP_o$, are the universal or mandatory groups. That information selected from SYNOP for the sensitivity analysis is from the universal groups. The complete symbolic form of message used by United States stations in the 49 continental states for the primary synoptic report is represented in Fig. 2.7.

Figure 2.7 Symbolic Primary Synoptic Report

IIiii Nddff VVwwW PPPTT
$N_hC_LhC_MC_H$ T_dT_dapp (99ppp)
$6P_oP_oP_oP_o$ ($7RRR_+s$) ($8N_sCh_sh_s$)
($9S_pS_ps_ps_p$) ($2R_{24}R_{24}R_{24}R_{24}$)
(3PWPWHWHW) (dWdWPWHWHW)
($4T_xT_xT_nT_n$) (Additional Plain Language Data)

Figure 2.8 is an example of an actual Service C teletype transmitted report. Only a meteorologist who works daily with these codes can remember and rapidly interpret significant weather information contained within this string of numbers.

Figure 2.8 Service C Teletype Transmission

```
SMUS1 KSTL Ø51800
72465 13313 80026 26204 23921 53112 53944 43917D
72458 13014 87030 25007 15672 55127 59722 K4428D
72456 03107 74728 25407 07902 54208 69925 44526

72446 22525 74728 24605 02922 57214 59865 44124D

72445
72434 23114 69011 23K04 21504 52123 53824 44235D

72439 82515 59022 21903 855// 52222 59939 43833D
72433
72432
72423 42911 66011 21809 21601 22127 53827 45834D

72456 22010 79211 25103 25700 58422 68645 43723D
72451 23112 74830 26107 11701 57123 69323 44417D
72452 +3413 07032 26408 00908 53127 59770 44721D
72449 75208 74821 24125 00906 +4572 59775 44226D
72347 82726 66031 23437 00907 58123 59362 44523D
72349 53611 63021 24624 00921 57303 59718 43925D
72363 87217 80022 25500 3097/ 59323 68970 43524D
72353 33114 80022 25107 00907 59833 59782 44528D

72356
72344 60405 82021 24908 30928 54800 53276 44753D
72347 52127 74031 22410 22978 23812 53025 45035D

72354 08104 56021 23512 00907 01825 53129 45536
```

Table 2.5 defines those symbols of the SYNOP code used in the CFAS computer sensitivity analysis.

TABLE 2.5 Definition of SYNOP Code Symbols

IIiii	Numeric code for reporting station
N	Fraction of celestial dome covered by clouds
N_h	Fraction of celestial dome covered by all the low cloud (s) present. If no low cloud(s) is present, that fraction covered by all the middle cloud(s) present
C_L	Type of low cloud if low cloud is present (Sc, St, Cu, C_b)
h	Height, above ground, of the base of lowest cloud seen
C_m	Type of middle cloud if middle cloud is present (A_c, A_s, N_s)
C_H	Type of high cloud if high cloud is present (C_i, C_c, C_s)
VV	Horizontal visibility at surface
W	Past weather
ww	Present weather

Service C reports are similar to Service A reports in that they are surface based observations and report much of the same information, such as, visibility, present weather, sea level pressure, temperature and dew point temperature. For the purposes of the sensitivity analysis the important Service C information which supplements the Service A reports is the detailed cloud information.

2.4 RADIOSONDE - UPPER AIR DATA

2.4.1 Station Location and Characteristics

There are 8 weather service stations within the 900 kilometer window which transmit radiosonde observations (RAOB), 7 stations reported regularly while one never reported in our data sample. These 7 stations report from five states: Florida, Georgia, Louisiana, Mississippi and Tennessee. The station locations range from 29° to 36° North Latitude and 82° to 90° West Longitude. The altitudes of the stations range from 0 to 326 meters above sea level. Table 2.6 gives a detailed account of each station which transmits radiosonde reports, the station identifier, location, latitude, longitude and altitude in meters. Figure 2.9 shows the stations and their locations within the 900 kilometer window. Notice that there are no radiosonde stations within the entire state of Alabama, which corresponds rather closely with the inner 500 km window where all detailed computer analyses are made.

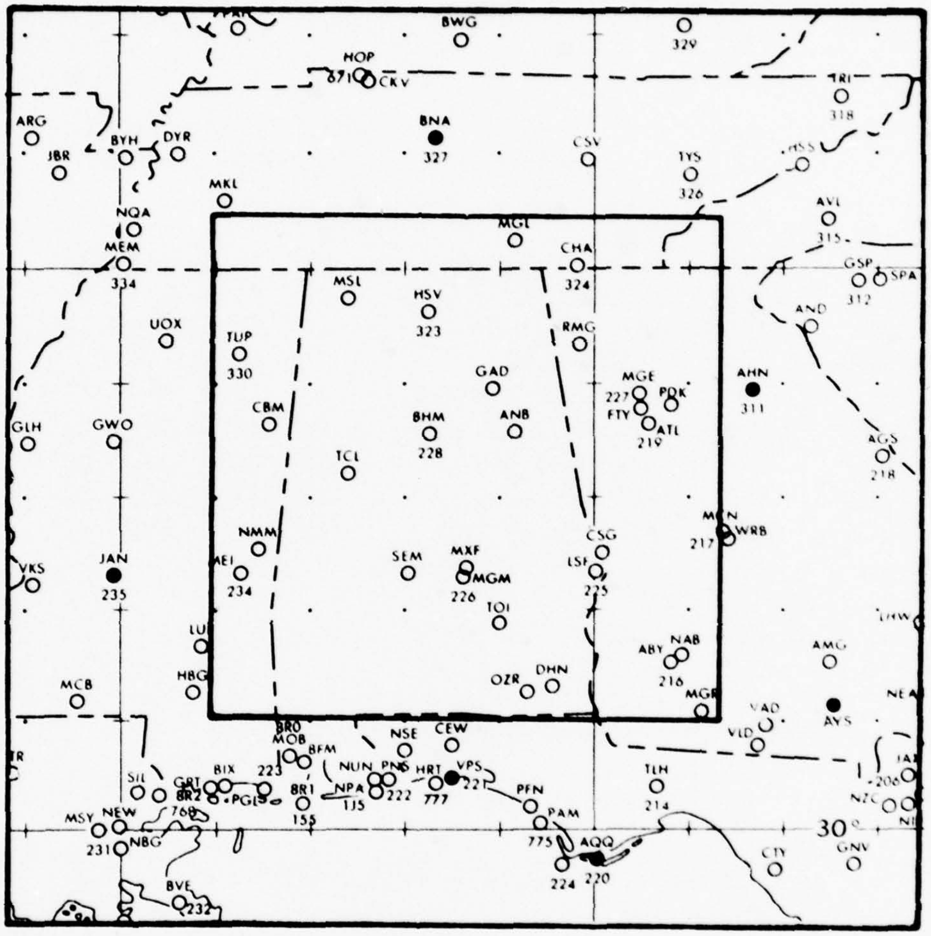

Fig. 2.9 RAOB Station Locations

TABLE 2.6 Radiosonde Station Information

STATION #	CALL LETTERS	NAME	LATITUDE NORTH	LONGITUDE WEST	ALTITUDE (METERS)
72213	AYS	WAYCROSS GA	31° 15'	082° 24'	46
72220	AQQ	APALACHICOLA FL	29° 44'	084° 59'	11
72221	VPS	ELGIN AFB FL	30° 29'	086° 31'	29
*72227		MARIETTA/ DOBBINS AFB GA	33° 55'	084° 31'	326
72232	BVE	BOOTHVILLE LA	29° 20'	089° 24'	0
72235	JAN	JACKSON MS	32° 19'	090° 05'	101
72311	AHN	ATHENS GA	33° 57'	083° 19'	247
72327	BNA	NASHVILLE TN	36° 07'	086° 41'	184

* Never reports in our data sample

2.4.2 RAOB Weather Code and Data Used

Upper air soundings or radiosonde observations (RAOB) are reported in the radiosonde message. The standard times of RAOB messages are 0000, 0600, 1200, and 1800 GMT. The reports are divided into four parts, PARTS A, B, C, and D, each one able to be handled as a separate message. Parts A and B report only data for levels up to and including the 100 mb level. Data for levels above the 100 mb level are

reported in Parts C and D. Parts A and B report the levels of observation of Army aviation interest, consequently, for the purposes of the CFAS sensitivity study we were concerned only with Parts A and B. The complete symbolic form of radiosonde message used by United States stations for Parts A and B is represented in Figure 2.10.

Figure 2.10 Symbolic Form of Radiosonde Message

PART A	TTAA	$YYGGI_d$	IIiii
	$99P_oP_oP_o$	$T_oT_oT_{ao}D_oD_o$	$d_od_of_of_of_o$
	00hhh	TTT_aDD	ddfff
	85hhh	TTT_aDD	ddfff
	70hhh	TTT_aDD	ddfff
	50hhh	TTT_aDD	ddfff
	40hhh	TTT_aDD	ddfff
	30hhh	TTT_aDD	ddfff
	25hhh	TTT_aDD	ddfff
	20hhh	TTT_aDD	ddfff
	15hhh	TTT_aDD	ddfff
	10hhh	TTT_aDD	ddfff
	$88P_tP_tP_t$	$T_tT_tT_{at}D_tD_t$	$d_td_tf_tf_tf_t$
	$\left.\begin{matrix}77\\ \text{or}\\ 66\end{matrix}\right\} P_mP_mP_m$	$d_md_mf_mf_mf_m$	$4v_bv_bv_av_a$
PART B	TTBB	YYGG/	IIiii
	$00P_oP_oP_o$	$T_oT_oT_{ao}D_oD_o$	
	11PPP	TTT_aDD	
	22PPP	TTT_aDD	
	33PPP	TTT_aDD	
	44PPP	TTT_aDD	
	........................etc.		
	51515	$101A_{df}A_{df}$	

Standard isobaric surfaces are referred to as mandatory levels which are reported in PART A of the radiosonde message. Data for these mandatory levels used by CFAS are the standard isobaric surface indicator, geopotential height, temperature and dew point depression.

Significant levels are defined as levels at which temperature and/or relative humidity data are sufficiently important or unusual to warrant the attention of the forecaster, and/or are required for precise plotting of the radiosonde observation. These significant levels are reported in PART B of the radiosonde message. A sufficient number of significant levels must be reported so that a linear interpolation between any two consecutively transmitted levels will give a close approximation to the observed data. Once again for the purposes of the sensitivity study the level indicator, temperature and dew point depression are the important pieces of information. With this information a determination as to whether or not a cloud layer exists at each mandatory or significant level can be made. CFAS will consider this RAOB information along with the Service A and C information and weigh that information presumed to be most reliable and combine that information unique to each, creating the most accurate fully detailed synoptic picture possible, before making the final grid point analyses. Figure 2.11 is an example of a RAOB teletype transmission. Table 2.7 defines those symbols of the radiosonde

TABLE 2.7 Definition of Radiosonde Code Symbols

IIiii	Numeric code for reporting station
99	Indicator figures. Identifies the surface data groups (i.e., $99P_oP_oP_o$)
hhh	Geopotential in geopotential meters, or tens of geopotential meters, of the standard isobaric surface specified by the surface indicator.*
T_oT_o	Observed temperature of the air in whole degrees Celsius at the surface
T_{ao}	Approximate tenths value and plus or minus sign indicator of the air temperature at the surface
00, 85, 70, 50, 40, 30, 25, 20, 15 and 10	Standard isobaric surface indicators. Identify the data groups for the 1000, 850, 700, 500, 400, 300, 250, 200, 150, and 100 mb levels in PART A
TT	Observed temperature of the air in whole degrees Celsius at the specified pressure level
T_a	Approximate tenths value and plus or minus sign indicator of the air temperature at the specified isobaric surface or significant level
11, 22, 33, etc.	Significant level indicator numbers in PART B

*Geopotential heights are reported in whole geopotential meters up to but not including the 500 mb surface. Geopotential heights are reported in tens of geopotential meters (i.e., decameters) for the 500 mb surface and higher

code used in the CFAS sensitivity analysis.

Figure 2.11 RAOB Teletype Transmitted Report (PARTS A and B)

```
UMMX2 MXBA 051200 RTD
TTAA  55124 76458 99010 11411 34205 00088 16257 34203 85462
12273 07503 70065 04269 25027 50574 10152 25054 40742 20931
25097 30958 37338 25082 457// 20228 555// 15408 611// 10554
703// 88999 56382 25104 434//I

TTBB  5512/ 76458 00010 11411 11032 16257 22982 17451 33763
09272 44700 04269 55602 00071 66557 05370 77500 12152 88475
12717 99449 15543 11436 20700 22100 20931 33348 27552 44312
34556 55279 39963 66221 515// 77153 595// 88150 611// 99100
703//I
```

2.5 VARIABLE STATION DENSITY DISTRIBUTION

Several station density distributions were used in the performance of the sensitivity analysis. The maximum station density available in the "Alabama Square" consisted of all of the Service A Airways stations included within the square. The fractional density distributions were created by eliminating selected stations from the data set.

The several station densities selected are listed in Table 2.8 together with the number of stations in the distribution and the mean distance between stations. Figures 2.12 through 2.18 illustrate the various station distributions listed in Table 2.8. Tables 2.9 through 2.14 show for each of the station distributions a list of the stations used and for each station the closest neighboring station and the distance between them.

The stations selected for elimination to produce the fractional density distributions were chosen subjectively such that the resultant station distribution was as uniform as possible. Starting with Figure 2.12, the full station density, the analyst eliminated 1/4, 1/2, 3/4, 7/8 and 15/16 of the full density stations to produce respectively the 3/4, 1/2, 1/4, 1/8, and 1/16 density station distributions. In the case of the 3/4 density station distribution we compared the results of the subjective

method with an objective technique. In the objective technique we eliminated 13 stations from the full station distributions which were closest to one another as per Table 2.9. The results obtained by the objective technique are shown in Figure 2.19 and Table 2.15. It will be noted that there is fairly good agreement between these results and those obtained by the subjective method.

TABLE 2.8 Station Densities Used in CFAS Sensitivity Analysis

Density	No. of Stations	Mean Distance Between Stations
Full	41	93 km
3/4	27	119 "
1/2	19	131 "
1/4	10	198 "
1/8	5	277 "
1/16	2	540 "
S.A.	20	N.A.

S.A. - Silent Area
N.A. - Not Applicable

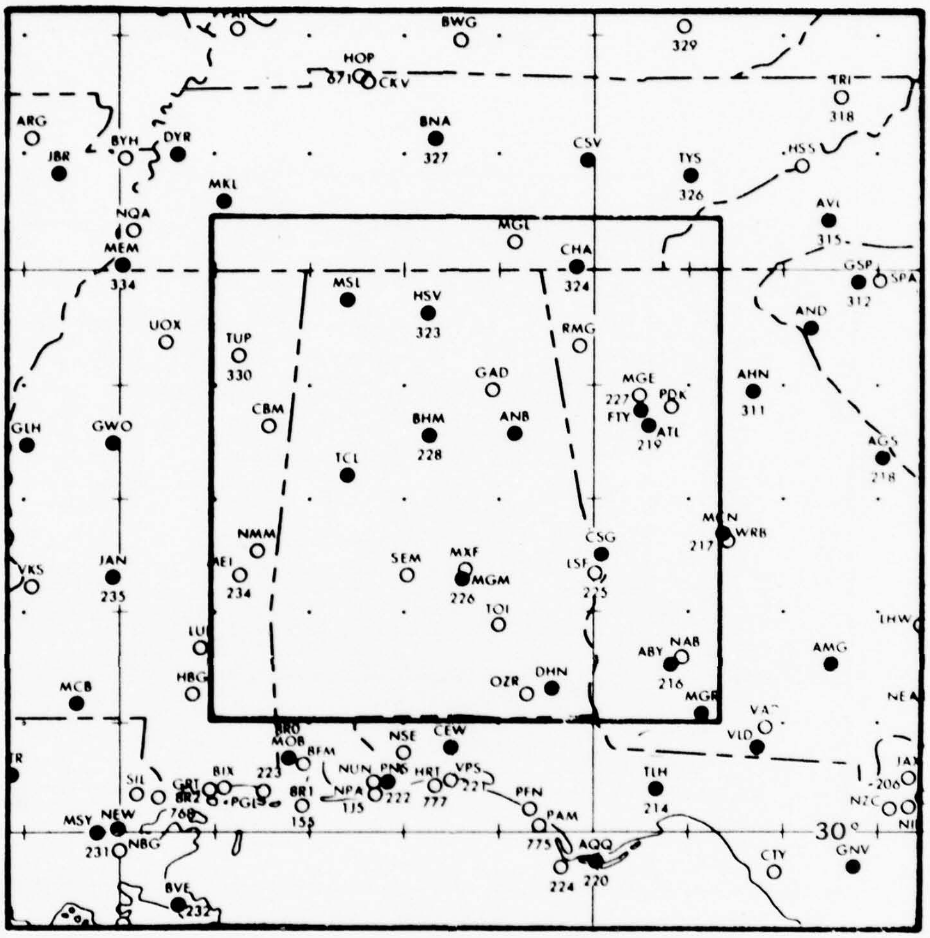

Fig. 2.12 Full Station Density

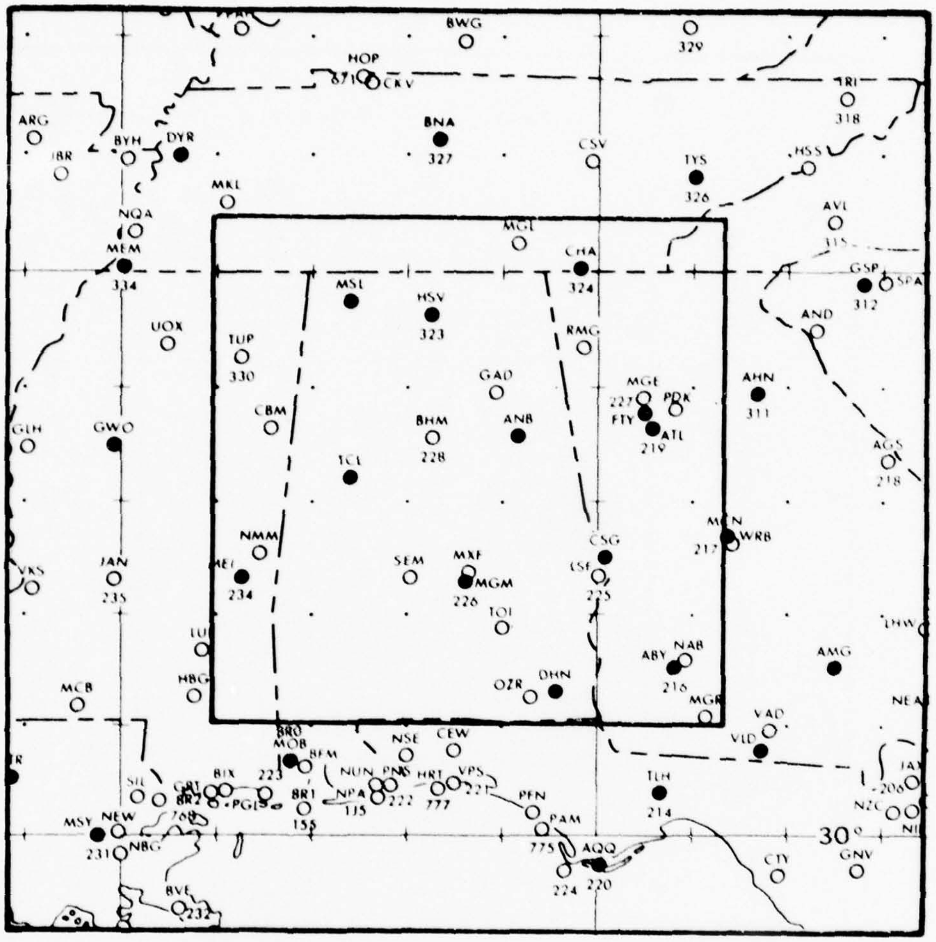

Figure 2.13 3/4 Station Density

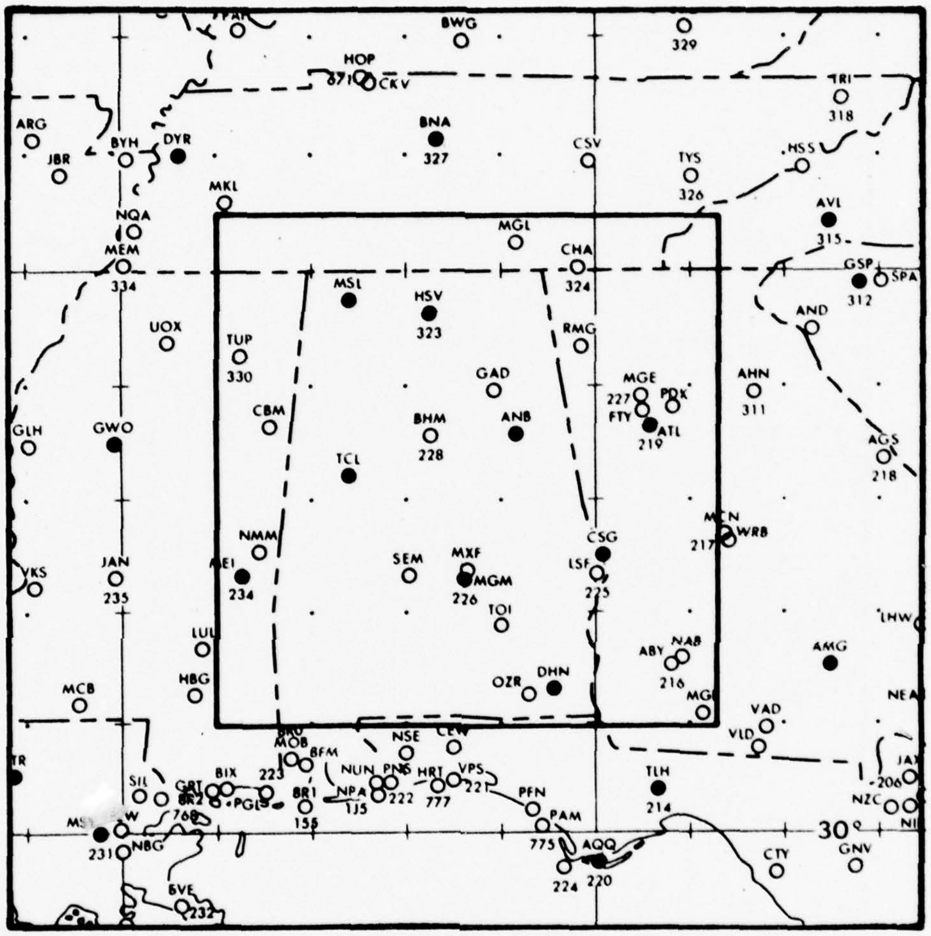

Figure 2.14 1/2 Station Density

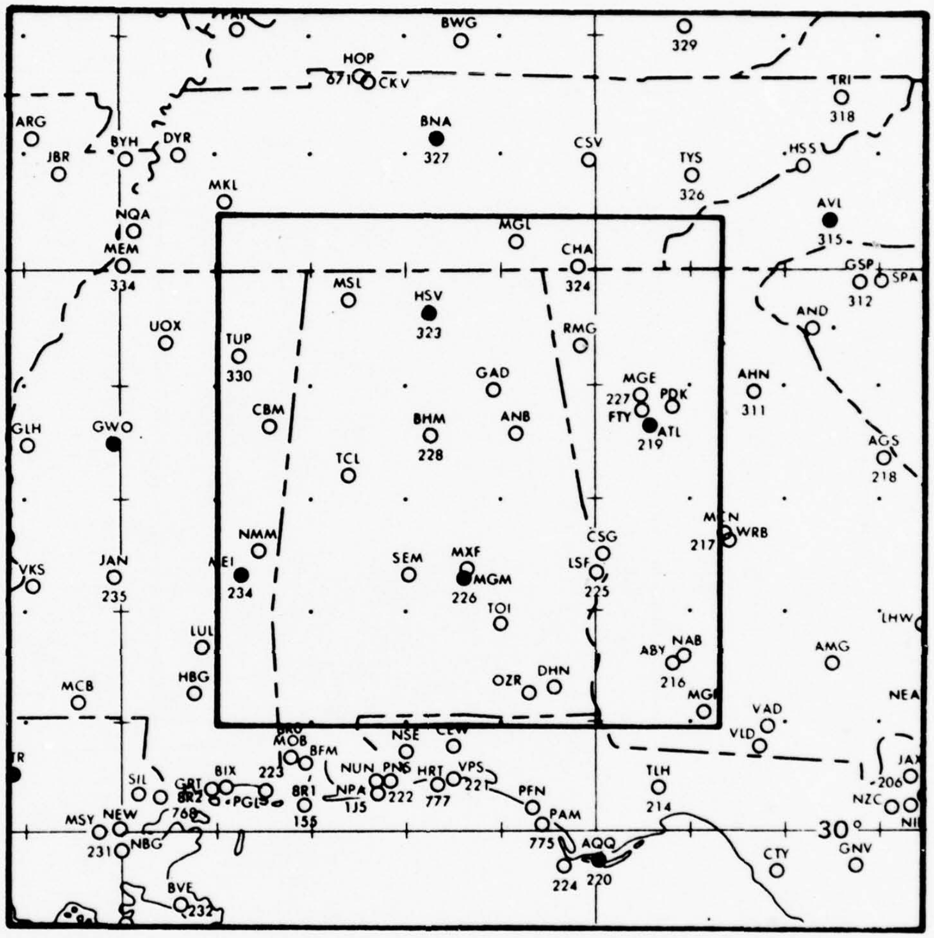

Figure 2.15 1/4 Station Density

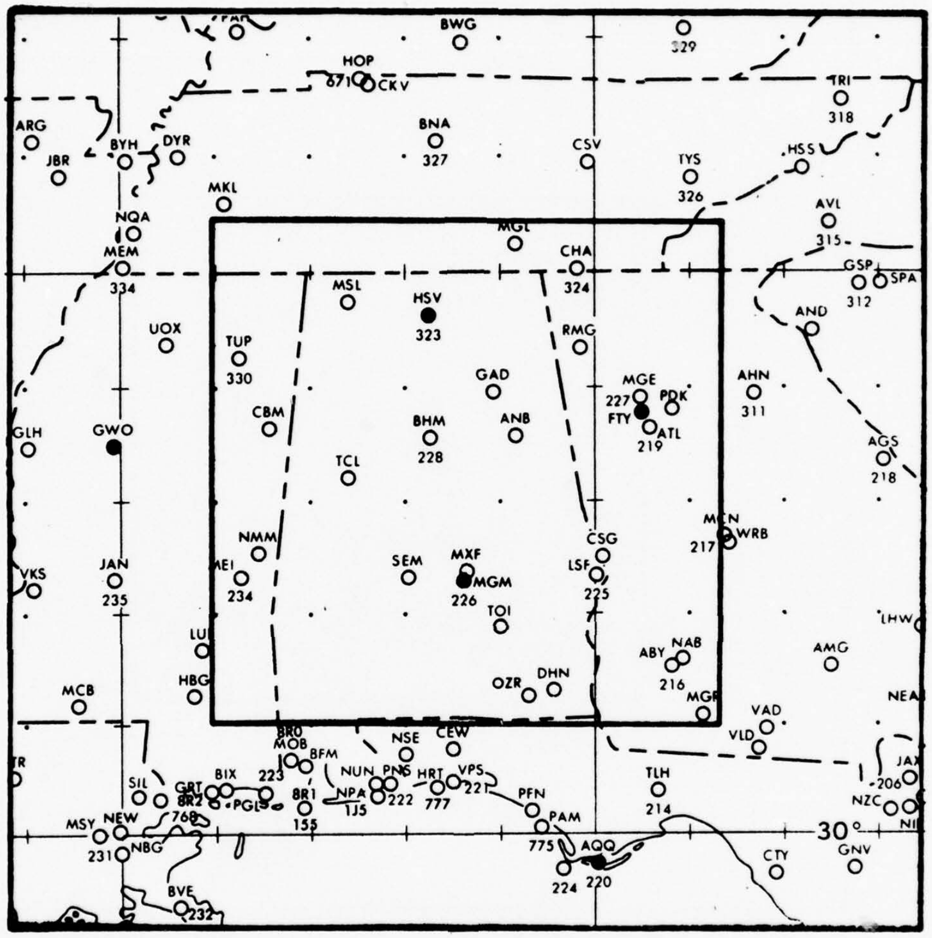

Figure 2.16 1/8 Station Density

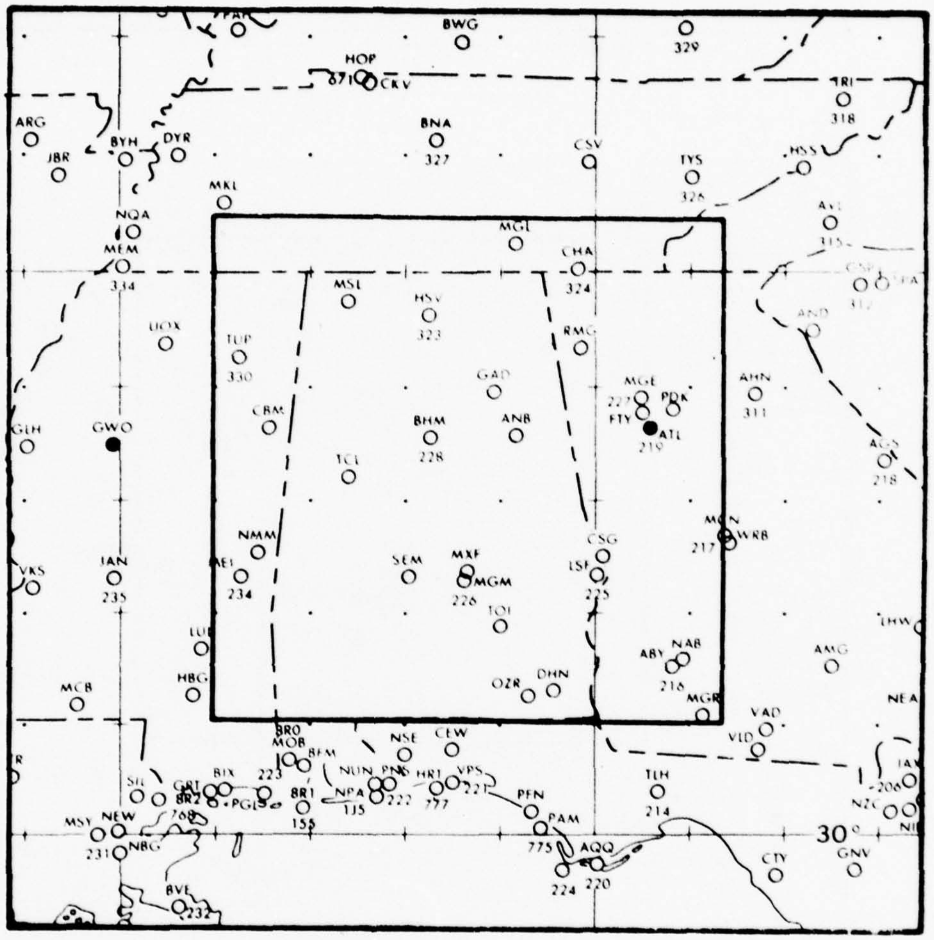

Figure 2.17 1/16 Station Density

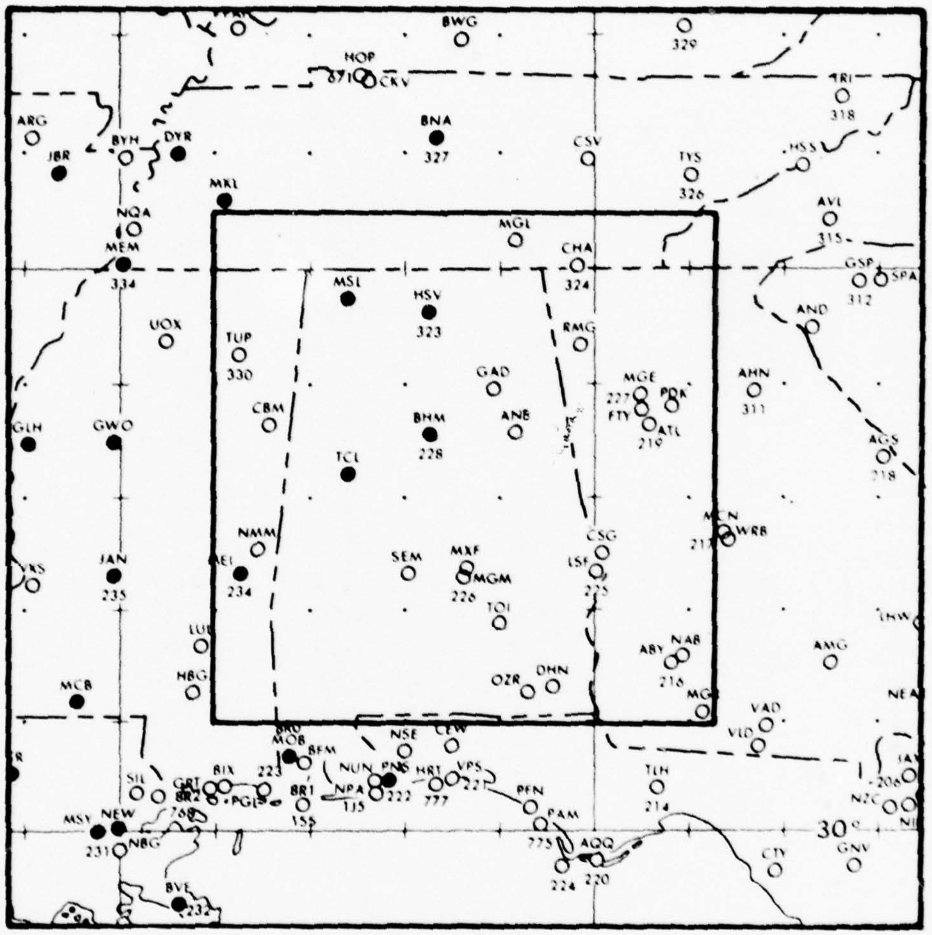

Figure 2.18 Silent Area Stations

TABLE 2.9 Full Station Density

Station	Nearest Neighbor	Distance Km	Station	Nearest Neighbor	Distance Km
ABY	MGR	55	GLH	GWO	83
AGS	AHN, AND	150	GNV	VLD	150
AHN	AND	90	GSP	AND	65
AMG	VLD	110	GWO	GLH	83
ANB	BHM	85	HSV	MSL	81
AND	GSP	70	JAN	MEI	125
AQQ	TLH	96	JBR	MEM	110
ATL	FTY	15	MCB	BTR	98
AVL	GSP	68	MCN	CSG	125
BHM	ANB	82	MEI	JAN	125
BNA	CSV	150	MEM	JBR	110
BTR	MCB	98	MGM	CSG, DHN	145
BVE	MSY	105	MGR	ABY	55
CEW	PNS	71	MKL	DYR	68
CHA	CSV	110	MOB	PNS	100
CSG	MCN	125	MSL	HSV	81
CSV	TYS	103	MSY	BTR	105
DHN	CEW	115	PNS	CEW	71
DYR	MKL	68	TCL	BHM	92
FTY	ATL	15	TLH	AQQ	96
			VLD	MGR	68

TABLE 2.10 3/4 Station Density

Station	Nearest Neighbor	Distance Km	Station	Nearest Neighbor	Distance Km
ABY	VLD	118	DHN	ABY	121
AHN	ATL	110	HSV	MSL	81
ANB	FTY	128	MEI	TCL	150
AMG	VLD	110	MEM	DYR	125
AQQ	TLH	96	MCN	CSG	125
ATL	FTY	15	MGM	CSG, DHN	140
BNA	HSV	170	MOB	MEI	188
BTR	MSY	105	MSY	BTR	105
CHA	TYS	145	TCL	MEI	148
CSG	MCN	125	TLH	AQQ	96
DYR	MEM	125	TYS	CHA	145
FTY	ATL	15	VLD	TLH	110
GSP	AHN	150	MSL	HSV	81
GWO	MEM	179			

TABLE 2.11 1/2 Station Density

Station	Nearest Neighbor	Distance Km	Station	Nearest Neighbor	Distance Km
ANB	ATL	135	GSP	AVL	70
AMG	TLH	212	GWO	MEI	181
AQQ	TLH	96	HSV	MSL	81
ATL	CSG, ANB	140	MEI	TCL	150
AVL	GSP	70	MGM	CSG, DHN	140
BNA	HSV	170	MSL	HSV	81
BTR	MSY	105	MSY	BTR	105
CSG	MGM, DHN, ATC	140	TCL	MEI	150
DHN	MGM, CSG	140	TLH	AQQ	96
DYR	MSL	222			

TABLE 2.12 i/4 Station Density

Station	Nearest Neighbor	Distance Km	Station	Nearest Neighbor	Distance Km
AQQ	DHN	180	DHN	MGM	140
ATL	MGM	240	GWO	MEI	181
AVL	ATL	271	HSV	BNA	170
BNA	HSV	170	MGM	DHN	140
BTR	MEI	305	MEI	GWO	181

TABLE 2.13 1/8 Station Density

Station	Nearest Neighbor	Distance Km	Station	Nearest Neighbor	Distance Km
AQQ	MGM	315	HSV	ATL	248
ATL	MGM	240	MGM	ATL	240
GWO	HSV	341			

TABLE 2.14 1/16 Station Density

Station	Nearest Neighbor	Distance Km	Station	Nearest Neighbor	Distance Km
ATL	GWO	540	GWO	ATL	540

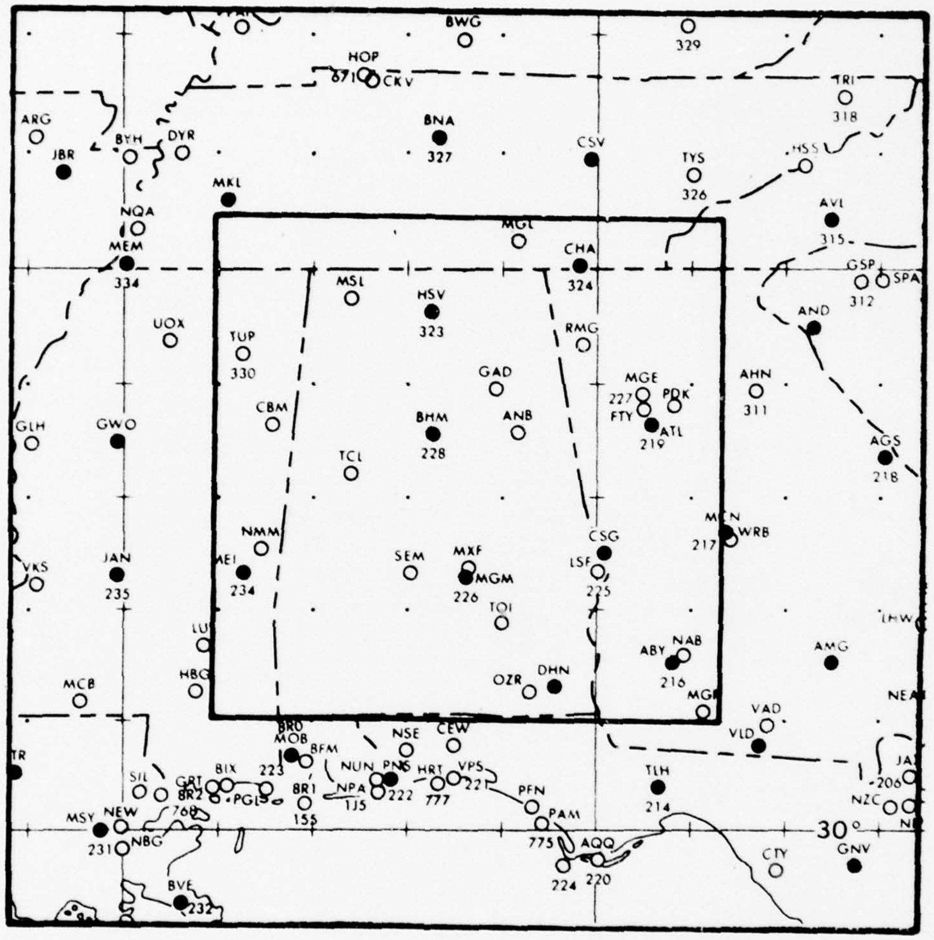

Figure 2.19 3/4 Station Density by Objective Technique

TABLE 2.15 3/4 Station Density by Objective Technique

Station	Nearest Neighbor	Distance Km	Station	Nearest Neighbor	Distance Km
ABY	DHN,VLD	120	GWO	JAN	130
AGS	AND	150	HSV	BHM	125
AMG	VLD	110	JAN	MEI	125
AND	AVL	105	JBR	MEM	110
ATL	MCN	130	MCN	CSG	125
AVL	AND	105	MEI	JAN	125
BHM	HSV	125	MEM	JBR	110
BNA	CSV	150	MGM	CSG,DHN	140
BTR	MSY	105	MKL	MEM	122
BVE	MSY	105	MOB	PNS	100
CHA	CSV	110	MSY	BTR	105
CSG	MSN	125	PNS	MOB	100
CVS	CHA	110	TLH	VLD	105
DHN	ABY	120	VLD	AMG,TLH	105
GNV	VLD	150			

Thus, Figures 2.12 to 2.17 show graphically the number and distribution of weather stations used to study the effect of data density on the objective analysis results. These cases are more representative of the type of data distributions expected, ranging from highly to sparsely populated regions. Figure 2.18, on the other hand, is more representative of a battlefield situation where observations exist in the friendly territory but none exist from the opponent's region, called a silent area. The influence of these data distributions on the CFAS analysis program is discussed in section 4.

2.6 SELECTED WEATHER SEQUENCES

This section contains plots of weather observed within the 900 km square centered about the state of Alabama. Eight time sequences of weather are plotted beginning 26 February 1977 at 1640Z and ending 27 February 1977 at 0810Z, as shown in Figures 2.20 to 2.27. This time series was used in analyzing and preparing material which demonstrates capabilities of automated weather depiction for pilots. Another weather plot is given for 7 March 1977 at 0026Z since it represents data used in the sensitivity study on the effects of changes in control parameters and type, distribution, and density of observations. Individual weather plots were made at each station location because the standard facsimile surface weather charts were not sufficiently legible, which is often the case when attempting to read printed detail from facsimile charts. The weather data were plotted from the teletype paper strips as follows:

1. scattered and broken clouds are indicated by a single and double vertical line through the station circle,

2. overcast skies are represented by a solid circle,

3. visibility is given in miles to the left of the station circle,

4. ceiling is given in hundreds of feet below the station circle, and

5. present weather symbols are located on the lower left side

of the station circle. Three horizontal lines indicate fog, the figure eight laying on its side implies haze, a comma and period represent drizzle and rain, respectively, a triangle depicts showers, and the capital letter R with an arrow represents a thunderstorm.

Progression of weather throughout the February time sequences varied considerably from good to bad flight conditions. The time series begins 26 February 1977 with 1600Z routine hourly weather observations and special observations up to 40 minutes past the hour plotted on the same chart. Whenever a special occurred, it was plotted in lieu of the hourly value to show the most current weather. One of the reasonings for presenting data in this manner is because the computer can rapidly update an analysis to account for significant weather changes. This feature of rapid updating and displaying most current weather is a distinct advantage made possible by the computer analysis system. Rather than have a pilot hover over the teletype output searching for specials of interest to him, the computer system can accomplish this task automatically plus properly assimilate, incorporate, and tailor this information to his needs. Thus, many of the weather plots were purposely selected at times other than those corresponding to the standard on-the-hour report. Not only does this allow for and incorporate more non-routine special observations but it is actually more realistic in terms of

what pilots experience. That is to say, a pilot may prepare for his flight at any time during the day and it would be unusual to correspond precisely with the fixed time of a routine meteorological observation.

Notice that the 26 February 1640Z map begins the weather sequence with clear skies in the eastern and cloudy conditions in the western section of map. Visibilities are high at all locations with the only reported restriction to visibility being haze at one location. Ceilings range from 2000 feet to unlimited in Alabama. Four hours later the first rain showers and thunderstorms begin to appear at the westernmost stations, yet the visibilities remain high. Three hours later at 0000Z February 27, showers and thunderstorms begin to restrict visibility, lower ceilings, and cause fog resulting from precipitation. A pattern becomes more discernible at 0340Z February 27 showing a northeast-southwest axis of rain, showers, and thunderstorms. This pattern prevails throughout the remaining time sequence, moves slowly eastward, and intensifies.

Ahead of the squall line in the clear eastern section, radiation fog is forming and restricting visibilities under clear skies. The radiation fog is pronounced only in the southeastern portion of the map and reduces visibilities to as low as one quarter of a mile. Many changes in mesoscale weather features are contained within this time sequence. Details

and changes will become more apparent when viewing results in chapter 5 provided by computer analyses.

The map for 7 March 1977 0026Z, Figure 2.28, constitutes the verification data used to study sensitivity of analyses due to type, distribution, and density of weather data. In addition to special weather observations at 0026Z, the available computer data base included all standard and non-routine observations for the previous 12 hours. The horizontal distribution of weather shows clear skies in the northwest section of the map, cloudy conditions along a northeast-southwest line, and haze, fog, drizzle, and rain dominating the entire southeastern sector. Visibilities ranged from one mile in rain and fog to 15 miles under clear skies. Ceilings ranged from being non-existent during clear and partly cloudy skies to a low of 300 feet in fog and rain. Thus, weather events depicted on the verification map show considerable diversity in type and range of values.

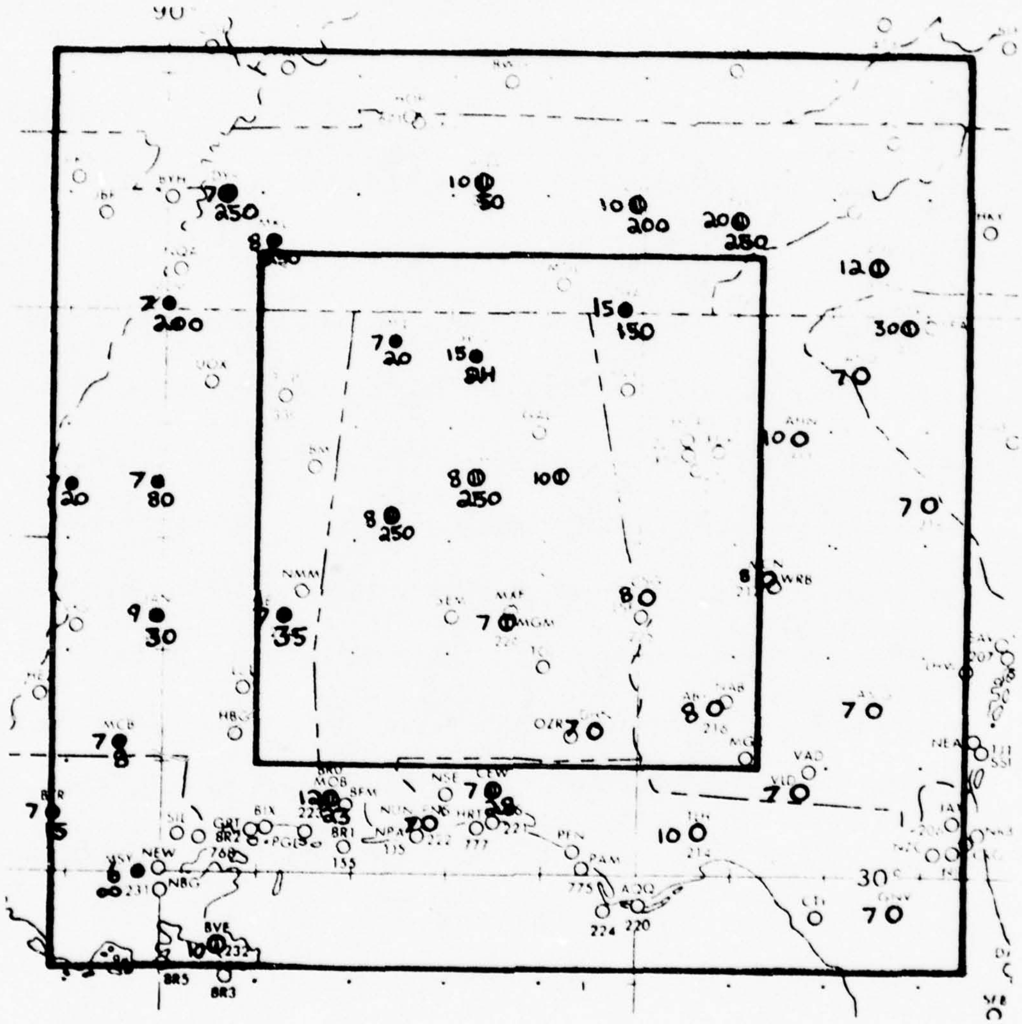

Fig. 2.20 Weather Map 1640Z Feb. 26, 1977

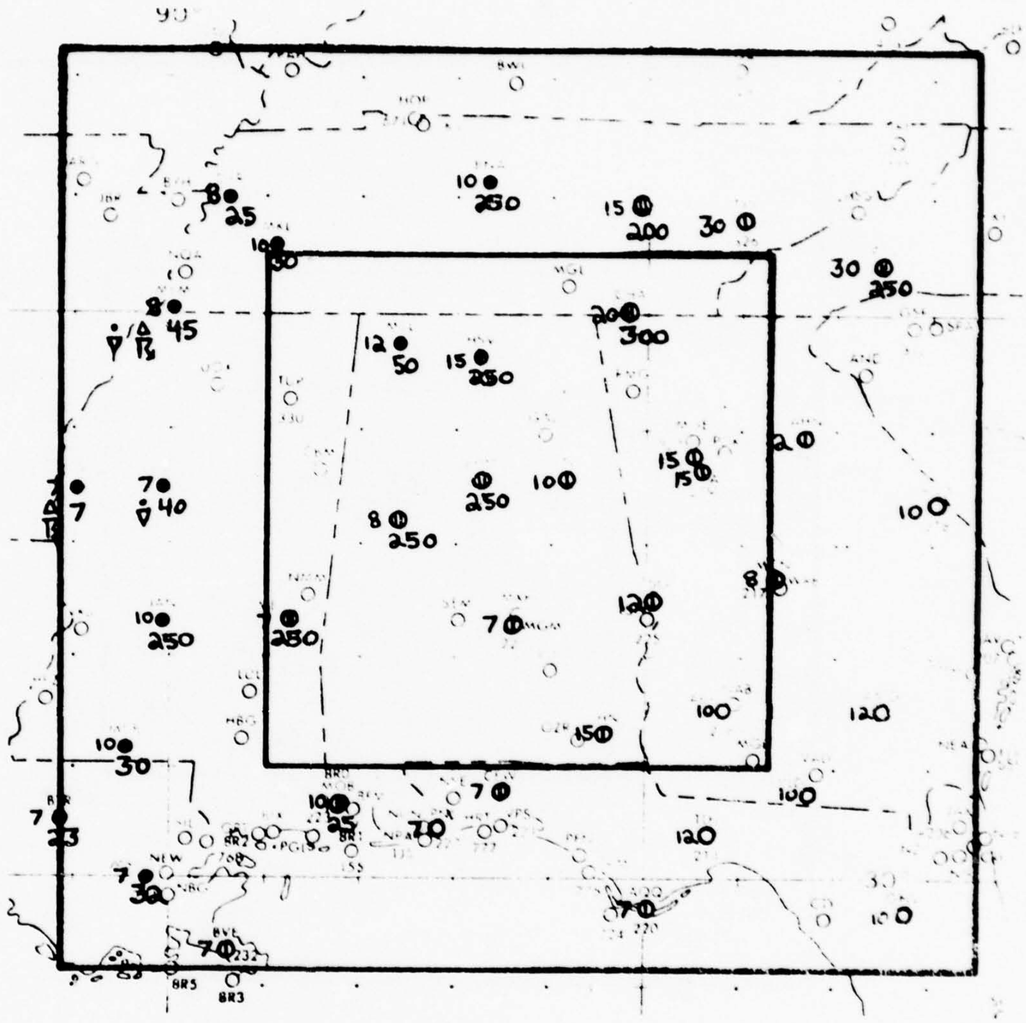

Fig. 2.21 Weather Map 2120Z Feb. 26, 1977

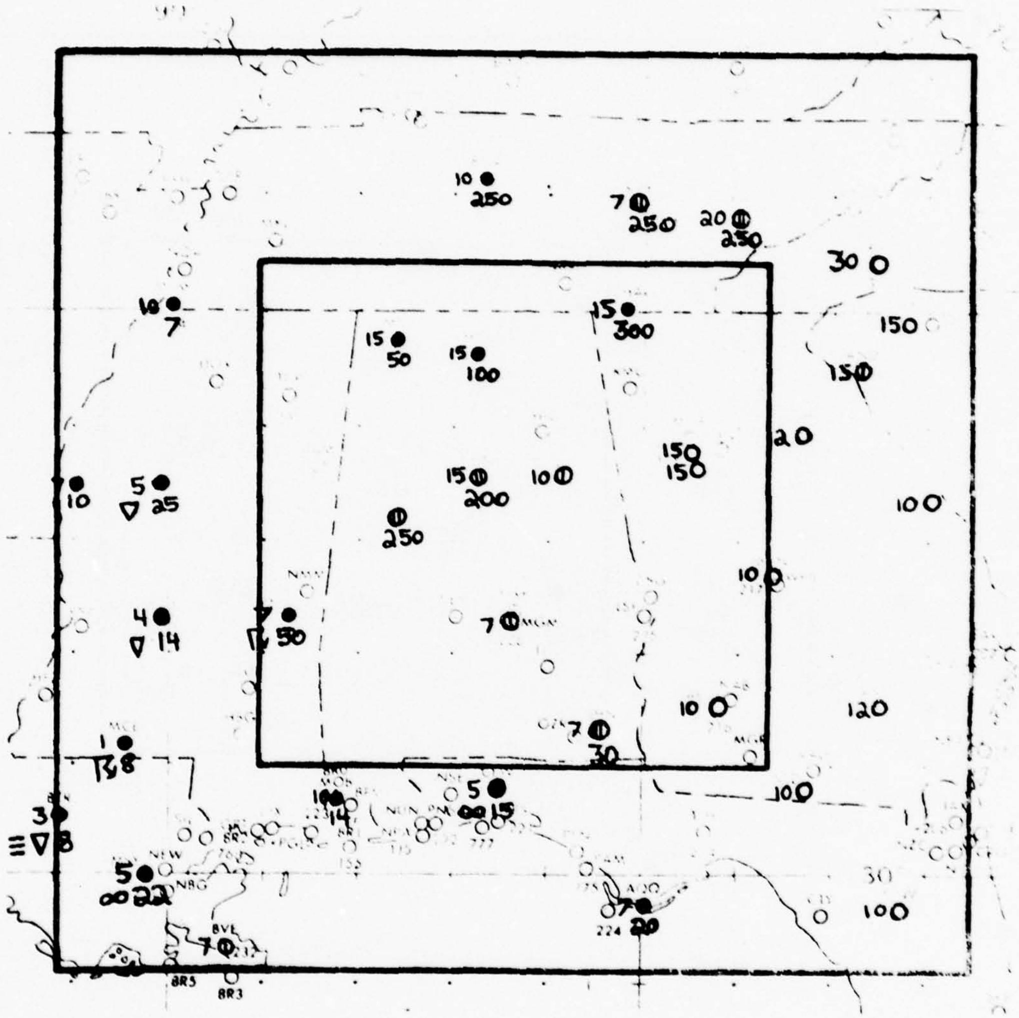

Fig. 2.22 Weather Map 0000Z Feb. 27, 1977

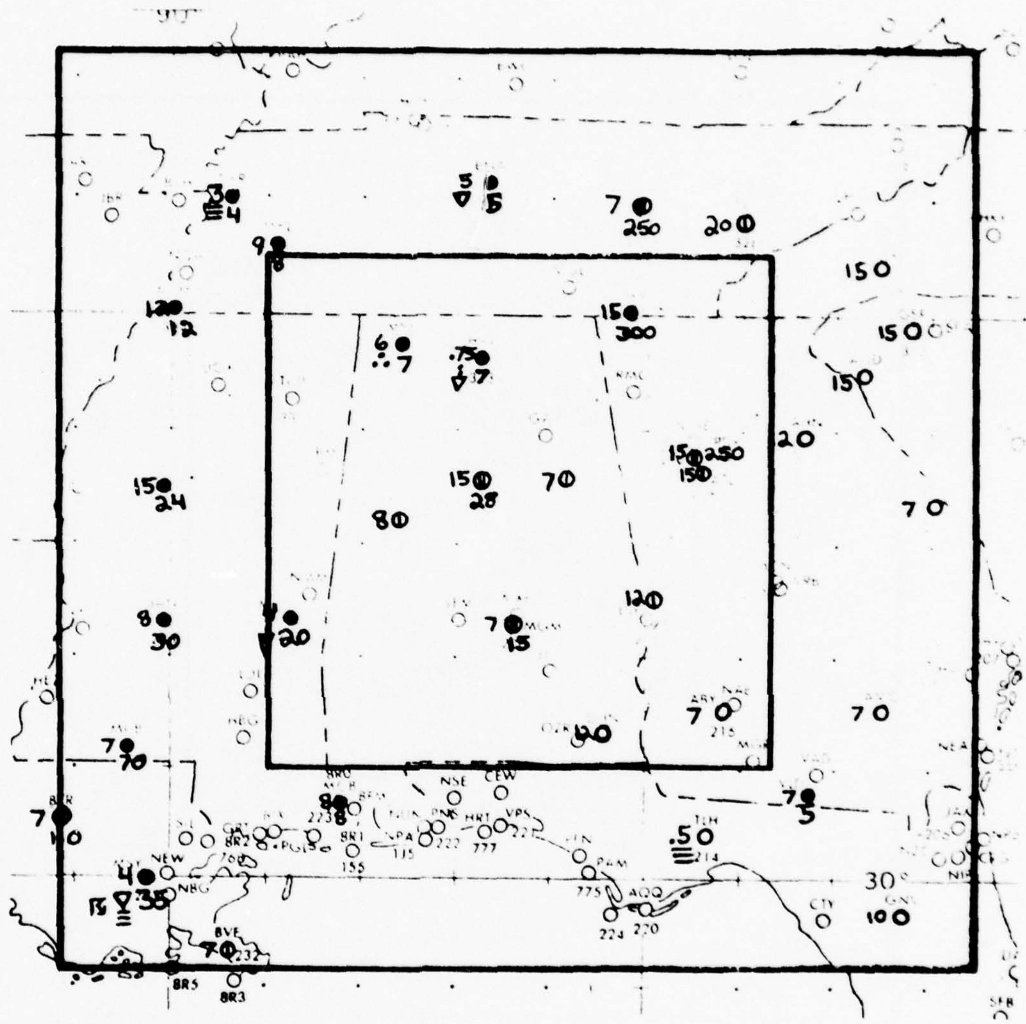

Fig. 2.23 Weather Map 0340Z Feb. 27, 1977

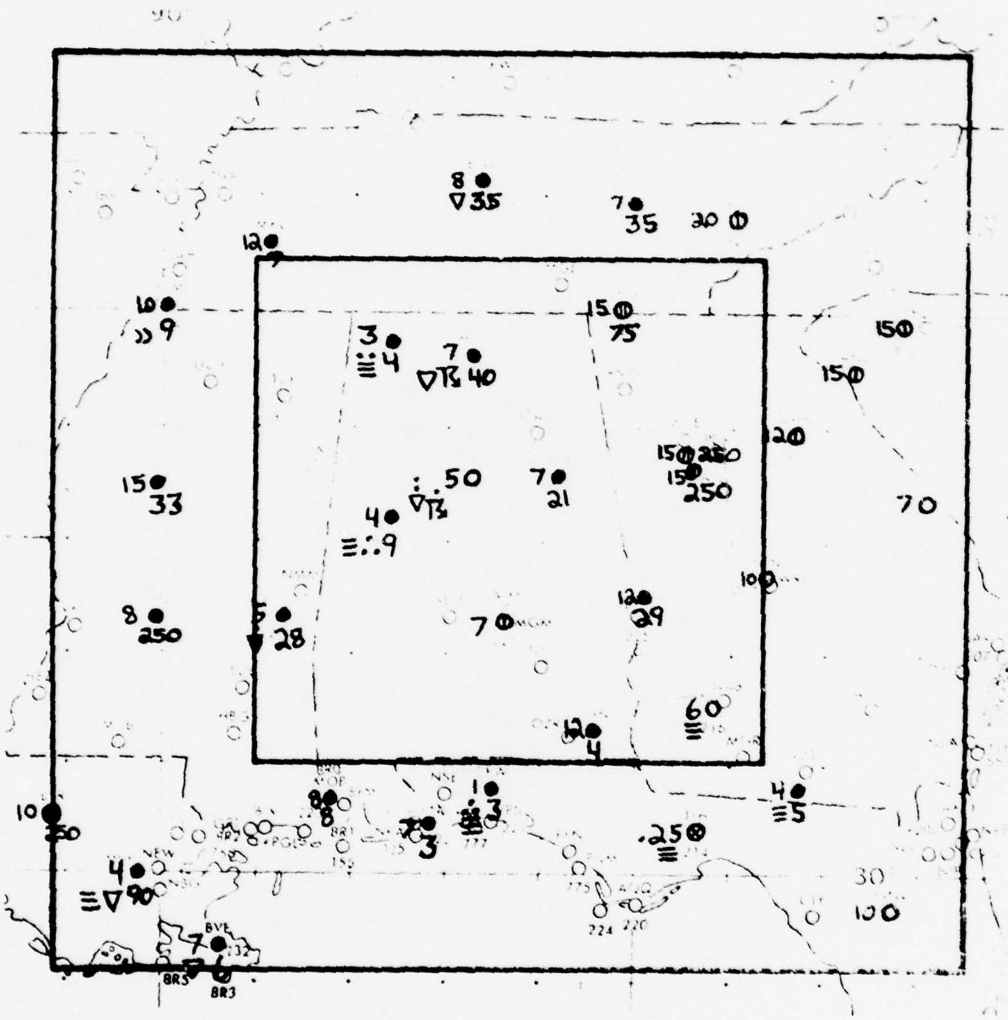

Fig. 2.24 Weather Map 0510Z Feb. 27, 1977

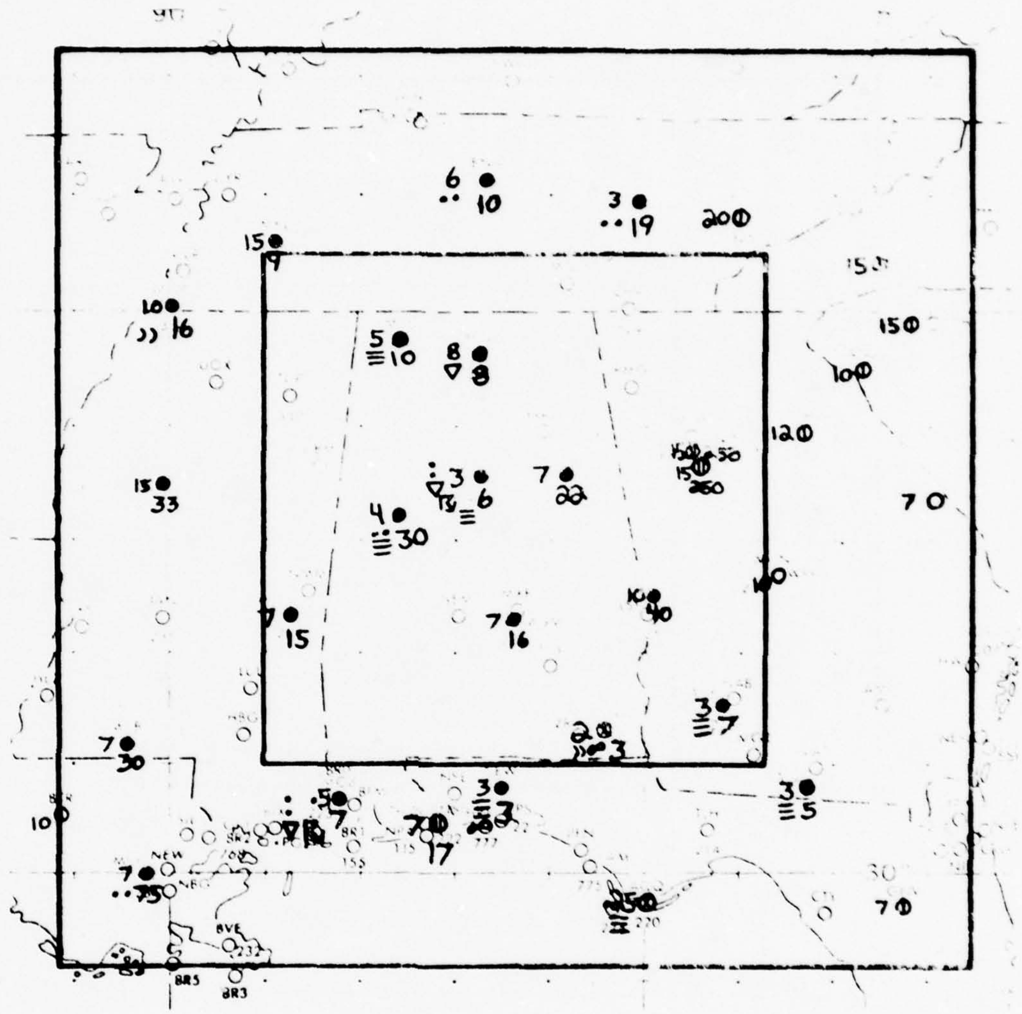

Fig. 2.25 Weather Map 0640Z Feb. 27, 1977

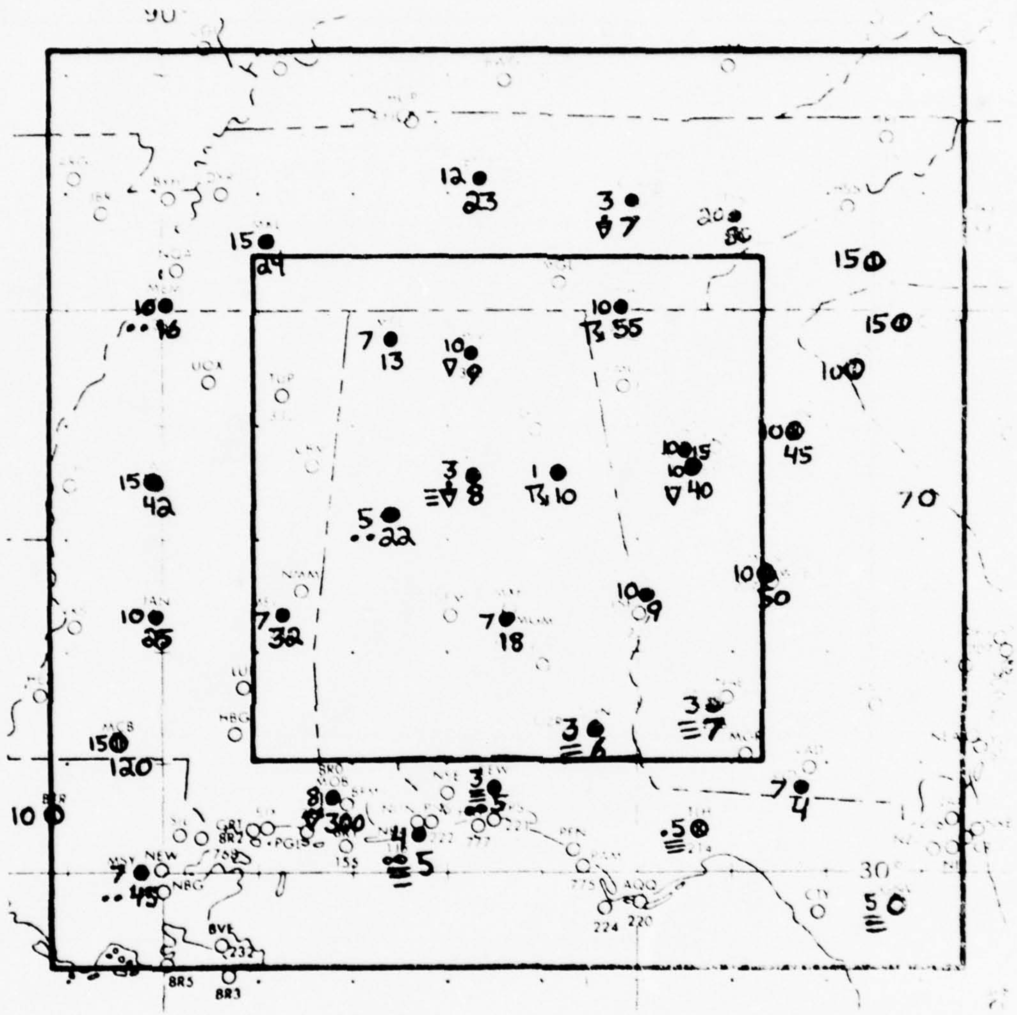

Fig. 2.26 Weather Map 0720Z Feb. 27, 1977

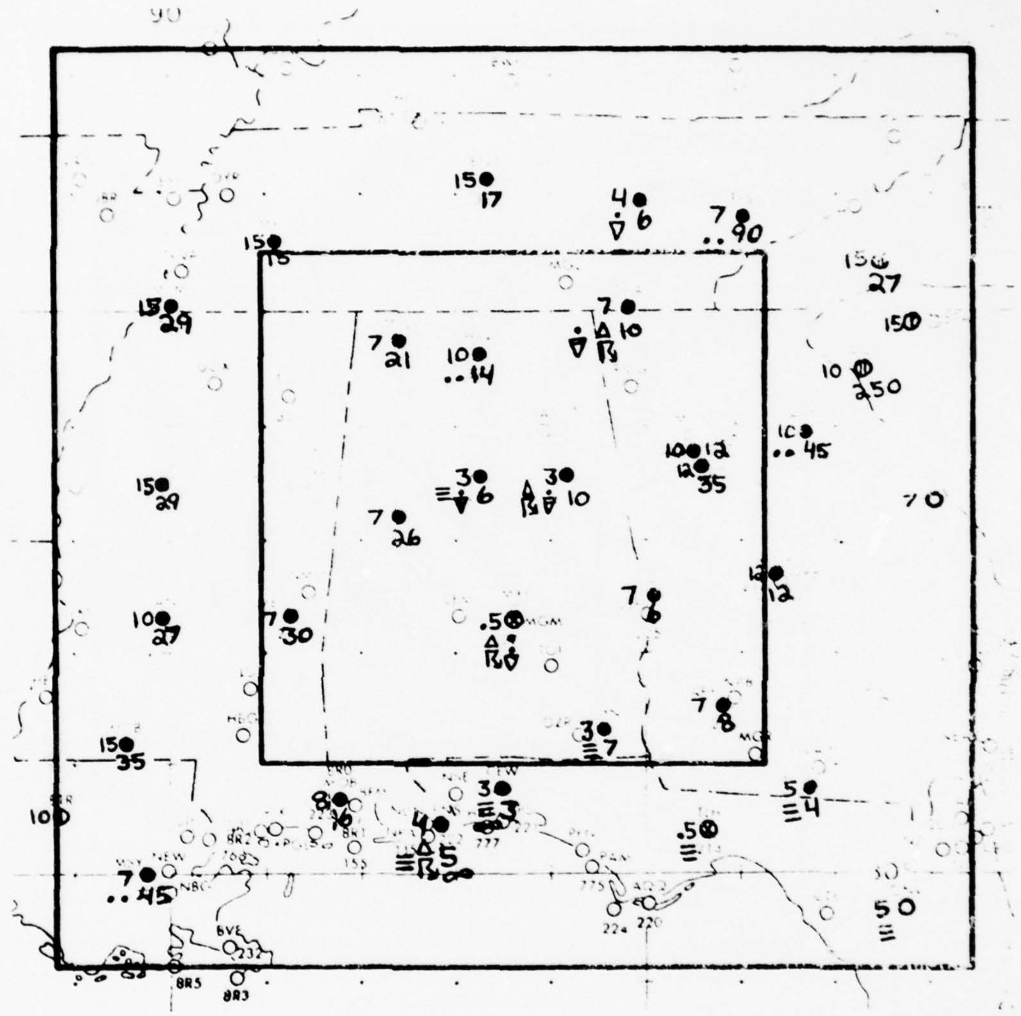

Fig. 2.27 Weather Map 0810Z Feb. 27, 1977

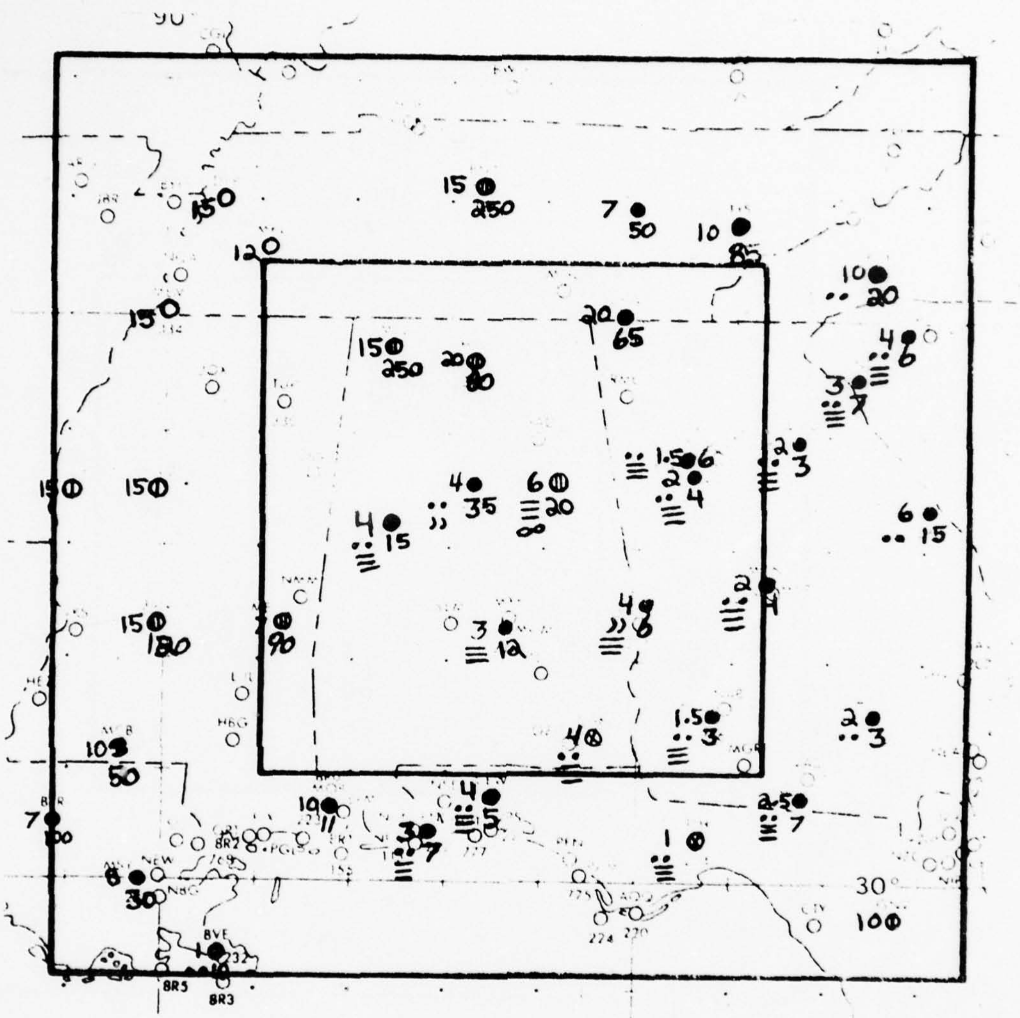

Fig. 2.28 Weather Map 0026Z Mar. 7, 1977

2.7 DATA ENTRY PROCEDURE

The Service A aviation hourlies, Service C Synoptic and Upper Air data were obtained in the medium of teletype printed paper from the National Weather Service Field Office in Atlanta, GA. A problem that had to be solved was that of putting a rather large amount of data onto a computer card or magnetic tape in the format required by the CFAS.

Our approach was to enter the data into the buffer memory of our Decwriter II LA-36 terminal in a format convenient to the operator. This enabled the data to be entered in considerably less time than would have been required had we used the CFAS format. The Decwriter's memory was sufficient to allow several hours worth of Service A, C and Upper Air datato be entered. However, for convenience, we entered only an hour's worth at a time. The off-line text editing capability of the Decwriter was used to check and correct errors in the data entry. After checking and correcting any errors, each hour's worth of data was output to a cassette tape and the memory cleared for entering another hour's worth of data. The format used in entering the three types of data is described in Tables 2.16, 2.17, and 2.18.

Several hours' worth of data were accumulated on a cassette. The entire data sample required fourteen cassettes. The cassette data

were input to mass storage files on a Decsystem 10 computer. A FORTRAN 10 program was written and implemented on the Decsystem 10 to convert the data from the fast entry format to the format required by the CFAS. The CFAS formatted data were then output to nine track binary tapes which could be read by the Univac 1106 on which our version of the CFAS is implemented.

Using the procedure outlined above a data base consisting of 9100 reports was created for analysis and use in this study.

TABLE 2.16 Format for Fast Entry of Service A Airways Data

Line	Data List
1	MMdd, HHmm
2	III, T_y, N_C, N_W, V
3 to 3 + N_C-1	hhh, N_S, h_C
3 + N_C	W_1, W_2, ... W_8
3 + N_C + 1	PPP, TT, T_dT_d

MMdd - Four digit date code MM = Month of year, 01-12
dd = Day of month, 01-31

HHmm - Four digit time code HH = Hour of day, 00-24
mm = Minute of hour, 00-59

III - Three letter station identifier

T_y - Type code A = SA, hourly airways
S = SP, special

N_C - Number of cloud layers reported, enter 1 if a clear sky

N_W - Number of weathers

V - Visibility in miles, fractions coded as a floating point decimal

hhh - Height of base of cloud layer in hundreds of feet

N_S - Literal description of cloud cover in the layer, i.e. OVC, SCT, BKN, CLR

TABLE 2.16 (Continued)

h_c - Ceiling layer designator, blank if not a ceiling layer
M if a measured ceiling layer
E if an estimated ceiling layer
MV or EV if the ceiling layer is variable

W_1, W_2, ... W_8 - Present weathers as per CFAS code Appendix II Table II - I Ref. 1

PPP - Pressure, mb

TT - Temperature, $^{\circ}F$

T_dT_d - Dew point temperature, $^{\circ}F$

Consecutive commas ',,' are used to indicate missing data items.

TABLE 2.17 Format for Fast Entry of Service C Synoptic Data

Line	Data List
1	MMdd, HHmm
2	III, T_Y, N_C, N_W, VV
3	N, N_h, C_L, h, C_M, C_H, W
4	ww
5	PPP, TT, T_dT_d

MMdd - Four digit date code, as described in Table 2.16

HHmm - Four digit time code, as described in Table 2.16

III - Three letter station identifier

T_Y = C for synoptic data

N_C = Number of layered cloud groups. This number was 0 for all of the synoptic messages in our data set

N_W = Number of weathers, equal to 1 for all of the synoptic messages in our data set

PPP = Pressure, mb

TT = Surface temperature, ^oC

T_dT_d = Dew point temperature, ^oC

N, N_h, C_L, h, C_M, C_H, W and ww are described in Table 2.5

Consecutive commas ',,' are used to indicate missing data items.

TABLE 2.18 Format for Fast Entry of Radiosonde Data

Line	Data List
1	MMdd, HHmm, III, T_y
2 to L_t + 1	PPPP, hhh, TT, T_dT_d

MMdd - Four digit date code, as described in Table 2.16

HHmm - Four digit time code, as described in Table 2.16

III - Three letter station identifier

T_y = R for Radiosonde Data

L_t = Number of levels of data

PPPP = Level pressure, mb

hhh = Level height, m

TT = Level temperature, ^oC

T_dT_d = Level dew point, ^oC

Consecutive commas ',,' are used to indicate missing data items.

3 UTILITY PROGRAM

3.1 PURPOSE AND DESCRIPTION

Numerous special purpose or utility programs were created for use in performing specific tasks in the sensitivity study and demonstration run. The purpose and description of each of these programs together with a listing is given in the subsections which follow. Each subsection title states the name of the main program which is described therein together with associated subprograms. The system on which the programs were implemented is indicated. The program listings are given in the appendix.

3.1.1 Program COLUMN (Decsystem 10)

Program COLUMN reformats the printout of data via the fast entry format. The reformatting done by COLUMN results in the data being output five columns to a page rather than one column as on input. This intermediate reformatting was done to facilitate error checking.

3.1.2 Program CONVER (Decsystem 10)

Program CONVER derives the relative UTM coordinates of each station in the data sample and generates the FORTRAN codes used in subroutine CONVRT which convert the three letter station code to relative UTM coordinates. Program CONVER utilizes subroutine UTM and requires the specification of the longitude and latitude of the southwest corner of the CFAS window and the central meridian of the window.

3.1.3 Program SYNOP (Decsystem 10)

Program SYNOP converts Service C Synoptic data from the fast data entry format to the format readable by the CFAS. Subroutine CONVRT is called by SYNOP to supply the relative UTM coordinates for the stations which are identified in the fast data entry format by their call letters.

3.1.4 <u>Program AIRWAY</u> (Decsystem 10)

Program AIRWAY converts Service A Airways reports from the fast data entry format to the format readable by the CFAS. Subroutines CLOUDS and WHETR are called by AIRWAY to convert the cloud and weather data from the fast data entry to the CFAS format. Subroutine CONVRT is called by AIRWAY to supply the relative UTM coordinates for the stations which are identified in the fast data entry format by their call letters.

3.1.5 Program .NEWUTM (Univac 1106)

Program .NEWUTM derives relative UTM coordinates for all stations in the data base. The latitude and longitude of the southwest corner of the window, as well as the central meridian are contained in a data statement. Subroutine .UTM is called by .NEWUTM to calculate the UTM coordinates. Program .NEWUTM was used in finding the optimal location of the CFAS window, i.e. a location which would maximize the number of stations included within the window and its border.

3.1.6 <u>Program .CFMAIN/STAT1</u> (Univac 1106)

Main program .CFMAIN/STAT1 and subroutine .EXEC1/STAT1 which are modifications of .CFMAIN and EXEC1, respectively, were used to interpret at one time the airways, synop, and RAOB observations constituting the complete data set for the statistical analyses and sensitivity evaluations of the CFAS. The interpreted observations are ouput to a mass storage file to be subsequently accessed by the routines which create the reduced or fractional density data sets.

AD-A071 452 GEO-ATMOSPHERICS CORP LINCOLN MA F/G 4/2
SENSITIVITY STUDY OF CFAS AND CFAR OBJECTIVE ANALYSIS TECHNIQUE--ETC(U)
FEB 79 W D MOUNT, B R FOW, B D MOUNT DAEA18-76-C-0060

UNCLASSIFIED ERADCOM/ASL-CR-79-0060-1 NL

2 OF 3
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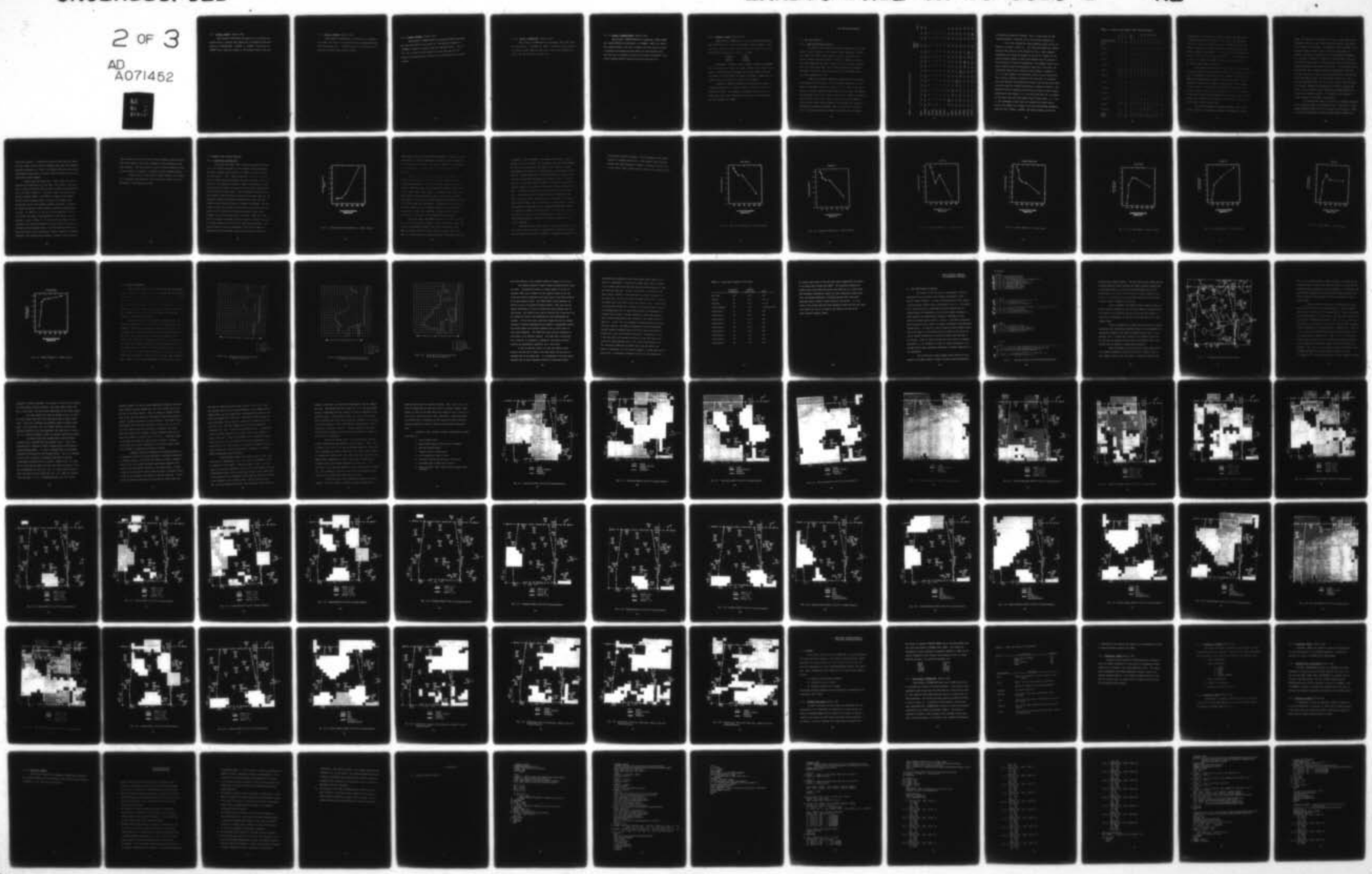
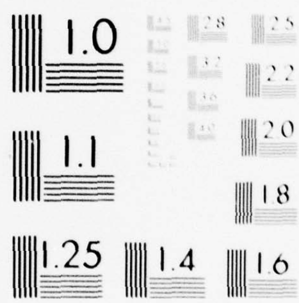
A071452





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

3.1.7 Program .INTPRT (Univac 1106)

Main program .INTPRT reads and prints out in a concise and readable format a selected mass storage file of interpreted observations created by .CFMAIN/STAT1, .OBSTIM, or .STDENS. The purpose of .INTPRT was to verify the contents of the fractional density data sets.

3.1.8 Program .OBSTIM (Univac 1106)

Main program .OBSTIM reads a selected file of interpreted observations and sends to an assigned file those observations taken between specified times. .OBSTIM was used to create data sets of observation spanning particular time periods.

3.1.9 Program .STDENS (Univac 1106)

Main program .STDENS creates the fractional density and silent area data sets from the full density set. The procedure employed in .STDENS is specific to stations within the "Alabama Square". The 3/4, 1/2, 1/4, 1/8 and 1/16 full density and silent area data sets are created by deleting from the full data set the observations from specific stations.

3.1.10 Program .CFMAIN/IJFL (Univac 1106)

Main program .CFMAIN/IJFL and subprogram .EXEC1/IJFL which are modifications of .CFMAIN and .EXEC1, respectively, were designed to create the IFILE, JFILE and BASE file for each of the fractional, as well as the full and silent area data sets.

3.1.11 Program .CFMAIN/TSK3RI (Univac 1106)

Main program .CFMAIN/TSK3RI and subprograms .EXEC1/TSK3RI and .EXEC2/TSK3RI are modifications of .CFMAIN, .EXEC1 and .EXEC2. The modified routines were used to perform only the functions involved in analyzing the observations and creating the cloud-fog data base. This was done to facilitate the rapid and economical evaluations of the results obtained with the fractional and silent area data sets.

3.1.12 Program .CFSTAT (Univac 1106)

Main program .CFSTAT reads in a user selected cloud-fog data base (CFDB) from mass storage and calculates various statistics of the sky cover, ceiling, visibility, present weather and layered cloud cover. The following subprograms are called by .CFSTAT:

.CEILING	.STATPK
.COVER	.VISIBL
.LAYERS	.WEATHR

Subprograms .CEILING, .COVER, .LAYERS, .VISIBL and .WEATHR scan, respectively, the values of ceiling, total sky cover, layered cloud cover, visibility and present weather stored in the CFDB to determine the number of missing entries and sends to subprogram .STATPK the non-missing entries from which the statistics are calculated.

Subprogram .STATPK calculates the mean value and variance of a specific parameter (i.e. ceiling, visibility, etc.) for a selected and ground truth CFDB. The covariance, correlation coefficient and root mean square error of the parameter with respect to ground truth CFDB are also calculated by .STATPK.

4 CFAS SENSITIVITY ANALYSIS

4.1 ALL DATA ANALYSES

4.1.1 CFAS Control Parameter Effects

An analysis was performed to determine sensitivity of the CFAS analysis output to changes in user inputted control parameters. All data for 7 March 1977 0026Z and the previous 12 hours were used in the control parameter sensitivity analysis. Table 4.1 contains a matrix of the control parameters and values used for each of 15 separate computer runs. The ground truth values of the control parameters are identified separately in the table. Each run was made by systematically varying one control parameter at a time.

Rather than attempt a subjective comparison of one map output with another for the many runs, a set of objective methods was used to provide a quantitative measure of "goodness of fit". Three such methods were used, namely, correlation coefficient, root mean square error (RMSE), and percentage of grid points missing. Each of these methods was applied to the 400 grid points for the analysis window encompassing Alabama. Only those grid points where an analysis was possible were included in computing the correlation and RMSE. The grid point where an analysis was not possible (missing) were tabulated separately and a percentage

TABLE 4.1 CFAS Parameter Values and Variations

													Ground Truth Values			Units
TIME	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	min
TYMOLD	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	min
NSSQ	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
ISSQ(1)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
ISSQ(2)	4	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
ISSQ(3)	-	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
ISSQ(4)	-	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
DSP	50	150	50	50	50	50	50	50	50	50	50	50	50	50	50	km
DIST(1)	20	20	10	40	20	20	20	20	20	20	20	20	20	20	20	km
DIST(2)	80	80	80	80	40	160	80	80	80	80	80	80	80	80	80	km
DIST(3)	100	100	100	100	100	100	50	200	100	100	100	100	100	100	100	km
TYMC(1)	50	50	50	50	50	50	50	50	25	100	50	50	50	50	50	min
TYMC(2)	120	120	120	120	120	120	120	120	120	120	60	240	120	120	120	min
TYMC(3)	150	150	150	150	150	150	150	150	150	150	150	150	150	75	300	min

of missing grid points was computed. Thus, a single value for each method represents a "goodness of fit" for the entire analyzed map.

Let us now consider the control parameter values used in the analyses, as shown in Table 4.1. The TIME and TYMOLD are constant values for the entire run series because the time to start accepting observations was always 30 minutes into the day of 7 March 1977 (to include specials reported at 0026Z) and extended back 720 minutes in time (12 hours) to include old observations. Two different patterns were used to search squares for observations surrounding a grid point. The ground truth values had four possible search squares to implement, 1, 2, 3, or 8 grid squares. All observations within one grid square would first be used in deriving an analysis at the grid point. If no observations were obtained, the program would index to the second search square value and search for available observations to perform an analysis. This procedure would be repeated until the maximum number of search squares allowable had been attained, i.e. 8 for the ground truth run. A separate run was made using only two possible search square values, i.e. 1 and 4. The performance of this latter run compared with ground truth is shown in the bottom row of Table 4.2 for four meteorological parameters, total sky cover, ceiling, visibility, and present weather, and for the

TABLE 4.2 Results Using Variable CFAS Control Parameters

	Sky Cover	Ceiling	Visibility	Present Weather	Cloud Cover in Nine Layers								
					1	2	3	4	5	6	7	8	9
Correlation Coefficient	.93	.84	.77	.68	.87	.80	.78	.76	.73	.69	.77	.75	.73
% of Grid Points Missing	0	0	0	0	0	0	0	0	0	0	0	0	0
RSME	11	64	6184	22	14	22	23	27	34	32	23	24	25
DSP=150													
	1	1	1	1	1	1	1	1	1	1	1	1	1
DIST(1)=10	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1
DIST(1)=40	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1
DIST(2)=40	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1
DIST(2)=160	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0
	.98	.97	.98	.99	.99	.99	.98	.99	.98	.98	.98	.98	.98
DIST(3)=50	0	0	0	0	0	0	0	0	0	0	0	0	0
	4.6	21.5	1435.5	3.1	3.6	4.4	4.9	4.5	6.4	7.7	5.6	5.4	5.1
	.99	.98	.99	.97	.99	.99	.99	.99	.99	.99	.99	.99	.99
DIST(3)=200	0	0	0	0	0	0	0	0	0	0	0	0	0
	3	18	766	5	1	1	2	2	3	4	3	3	4
	1	1	1	1	1	1	1	1	1	1	1	1	1
TYMC(1)=25	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1
TYMC(1)=100	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1
TYMC(2)=60	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	1	1	1	1	1	1	1	1	1	1	1
TYMC(2)=240	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0
	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99
TYMC(3)=75	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	114	2	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	.99	.99	.99	.99	1	1	.99
TYMC(3)=300	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	1	39	0	1	1	1	1	1	1	1	1	1
NSSQ=2	.94	.92	.94	.95	.93	.90	.90	.93	.93	.93	.93	.91	.89
ISSQ(1)=1	2.7	5.	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	6.5
ISSQ(2)=4	8	38	2926	7	9	13	14	13	14	14	13	14	15

percent cloud cover within the nine layers specified in CFAS to cover the altitude range from the surface to 3000 meters. The correlation coefficient, percent of missing grid points, and RMSE values are presented in that order for each meteorological parameter associated with NSSQ=2, ISSQ(1)=1 and ISSQ(2)=4. For sky cover, the correlation was 0.94, the percent missing grid point data was 2.7 and the RMSE was 8 percent. The units of the RMSE for each meteorological variable is the same as those listed in Table 1.1.

Notice that of all the runs, the only time it was not possible to obtain an analysis at a grid point was when only two search squares were used. A degradation is also shown via the correlation coefficient and RMSE for all meteorological variables. The average Univac 1106 time to complete an analysis was 3 minutes for all data and 4 search squares. By having only two search values the computer time necessary for conducting an analysis was reduced by 18 percent. Thus, it is possible to reduce the computer time significantly by varying the number of search squares. The results do show, however, that care must be exercised in the choice(s) of search square values.

The effect of changing the distance parameter, DSP, from 50 to 150 km had the most pronounced influence on changing the analysis

output. The purpose of this parameter is to form a single "best report" on weather observed by two or more very close stations, those within a DSP distance of one another. The advantage of this parameter in the objective analysis scheme is that it allows an operationally more important observation to supersede a less critical nearby observation. This procedure is applied on a variable by variable nature so that the "best report" could contain a ceiling observation from one station and a visibility observation from another close station. The intent was to use this procedure only to handle simultaneous observations in time that were also very close in space, say within, plus or minus, one grid unit of the final analysis mesh. From the results in Table 4.2 it can be seen that increasing DSP to 150 km or, plus or minus, three grid units is too coarse. Although this parameter has no effect on missing grid points, it does provide the worst correlation and largest RMSE for all thirteen listed weather variables. It is clear that this parameter is vitally important to the quality of the analysis.

The standard DSP value of 50 proved to be perfectly acceptable for the data dense region of southeastern U.S.A. There were no "dual" stations reporting within 50 km of one another for this region so a DSP of 50 was the best value to select to provide spatial resolution for

ground truth analyses. A question that does not arise with this normal type data sample but that could be important under close and conflicting battlefield observations is, what is the optimum DSP value that provides discrimination among reports, maintains spatial resolution, yet emphasize operationally critical features?

Distance and time scale factors, used to weigh the value or influence of an observation on a grid point, were varied to allow for a range of values from half as small to twice as large as the ground truth value, as shown in Table 4.1. The first, second, and third distance and time constants (DIST ( ) and TYMC ( )) appear in the analysis scheme to treat convective (local), convective with middle clouds (mesoscale), and all other weather conditions separately. In general, the sphere of influence of local weather is limited to small distances and time, i.e. DIST (1) = 10, 20, or 40 km and TYMC (1) = 25, 50, or 100 minutes. The range of the mesoscale and other distance and time constants is given in Table 4.1. It can be seen from Table 4.2 that variations in the local and mesoscale distance and time constants have no effect upon the analysis results. The third distance and time constants that applied to all non-convective weather situations did produce variations in the computer output analyses. However, these differences

were extremely small for all variables except visibility, which should be looked into further in view of the importance of this parameter to many Army operations. The main point to be made is that the analysis results are not sensitive, nor critical, to distance and time weighting factors.

Overall it can be stated that no violent changes in the analysis due to changing input parameters were detected that would indicate any instabilities in the analysis procedures.

4.2 VARIABLE DATA DENSITY ANALYSES

4.2.1 Correlations and RMS Errors

The ground truth CFAS control parameters described in section 4.1.1 were applied separately to every available station observation and then to variable station densities to perform a series of analyses for 0026Z March 7, 1977. Maps showing full, 3/4, 1/2, 1/4, 1/8, and 1/16 station density distributions are given in Figures 2.12 to 2.17, inclusive. The correlation coefficient, RMSE, and percentage of grid points missing an analysis were derived for each station density using the full data set as ground truth. These computations were made for each analysis of the 400 inner grid points that encompass Alabama. The correlation coefficient and RMSE computations were made only with respect to those grid points where an analysis was possible. The percentage missing value accounts for the number of grid points where an analysis was not possible even though the maximum search square available for use was eight grid units or 200 km. Figure 4.1 shows that the percentage of missing grid points remains essentially zero until an average distance of 300 km or more exists between stations. This average distance of 300 km corresponds to only 1/8 the number of stations where all are included. These missing grid point results are

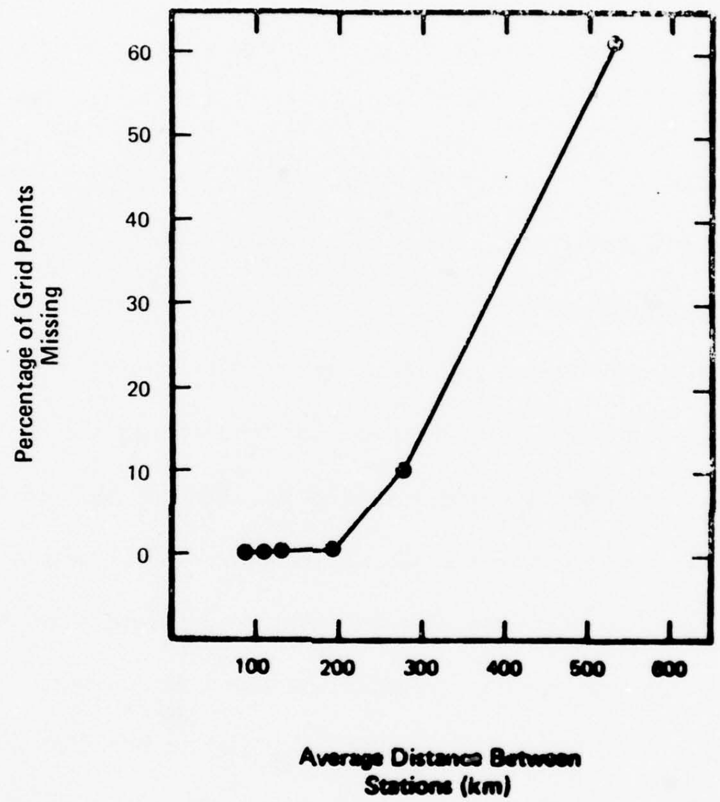


Fig. 4.1 Missing Grid Point Analyses vs. Station Density

independent of the type of meteorological variable. It can also be seen from Figure 4.1, that the CFAS analysis program, using a maximum of eight grid unit search squares, can force an analysis at more than 90% of the grid points even though only 1/8 the original stations are available.

Figures 4.2 to 4.5 show the decay of the correlation as distance between stations increases. These results were obtained for four meteorological variables, sky cover, visibility, ceiling, and present weather. All decay curves are reasonably well behaved except for one or two points on the ceiling display. In general, as the average distance between stations doubled from 100 to 200 km, the correlation coefficient for sky cover and visibility dropped to 0.7 which means that 50% of the variance was unexplained. Conditions are even worse for analyzing ceiling and present weather variables from limited weather observations. In this case a doubling of distance between stations resulted in only about 16% of the variability being explained.

Root mean square error (RMSE) results are presented in Figures 4.6 to 4.9 for sky cover, visibility, ceiling, and present weather. All of these meteorological variables show a rapid deterioration in the RMSE as distance between observing stations increases from 100 to 200 km. Beyond that point, deterioration either slows down, levels off,

or improves. The worst RMSE is 20 percent for sky cover, 1 km for ceiling, 13 km for visibility, and 30 category units for present weather. The impact of data density on the quality of the analysis is shown graphically by the rapid decay or deterioration as observational densities decrease. Another factor that is adversely affected as station density decreases in the increased running time required to make a computer analysis. It was found that the computer execution time to perform an analysis doubled as the number of observation stations decreased by a half. To state this another way, less data requires longer computer runs. The reason for this is the fact that the computer takes more time to search the area. This increases as the square of the distance to the nearest station, and, in the process, a larger number of distant observations are found that must be interpreted and weighted properly to complete the analysis at each grid point. It is possible to minimize this time effect for any given data distribution by selecting less stringent CFAS control parameters, such as the number and interval of search squares allowable.

Although all data density analyses, including silent area, used only routine surface and upper air observations, it should be mentioned that the CFAS has the built-in capability to incorporate pilot reports and

meteorological satellite information. Such observations could greatly improve the available data density. At the present state-of-the-art, satellite data would definitely be helpful in improving sky cover and, to a far lesser extent, present weather, ceiling, and visibility results.

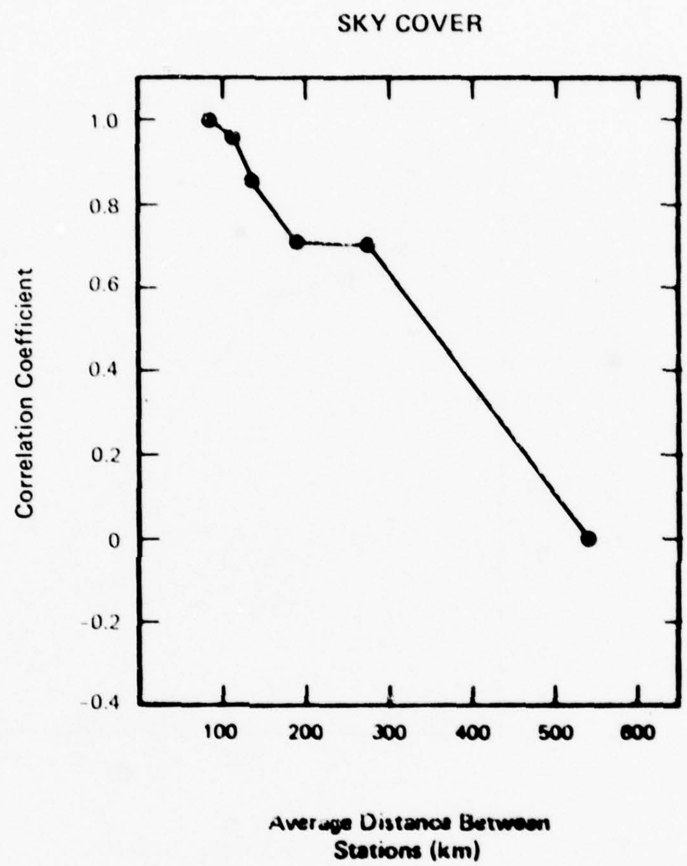


Fig. 4.2 Sky Cover Correlation vs. Station Density

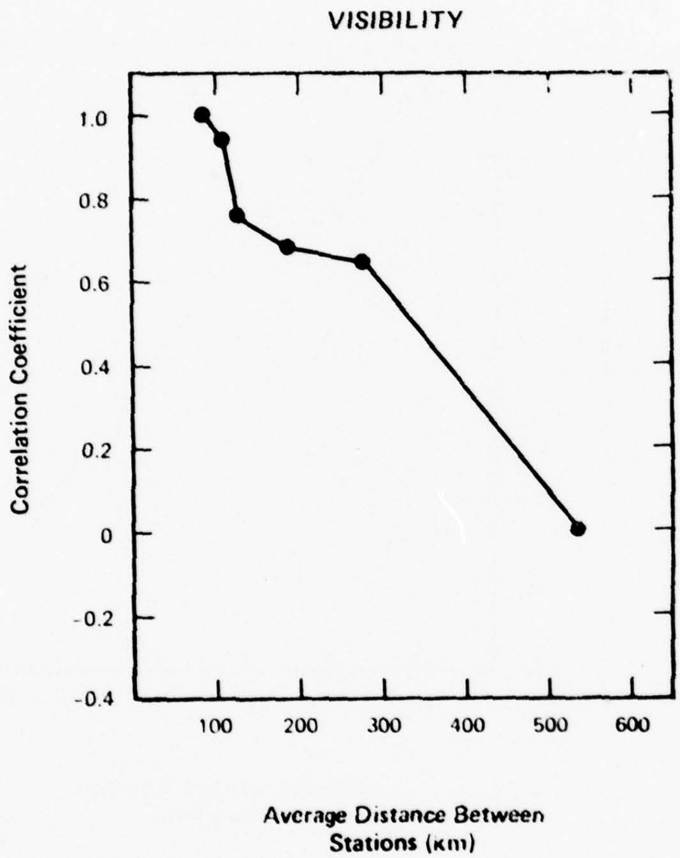


Fig. 4.3 Visibility Correlation vs. Station Density

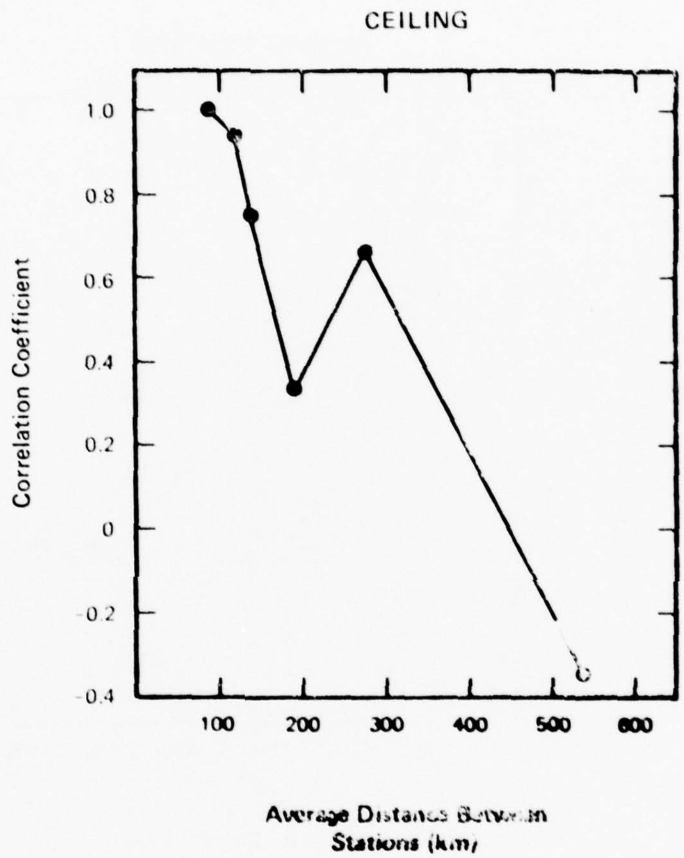


Fig. 4.4 Ceiling Correlation vs. Station Density

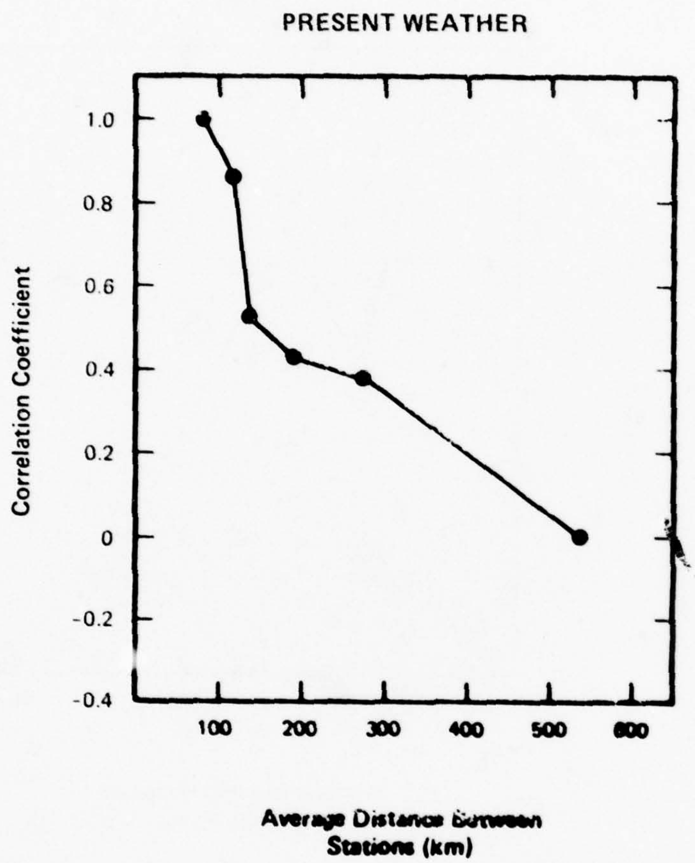


Fig. 4.5 Present Weather vs. Station Density

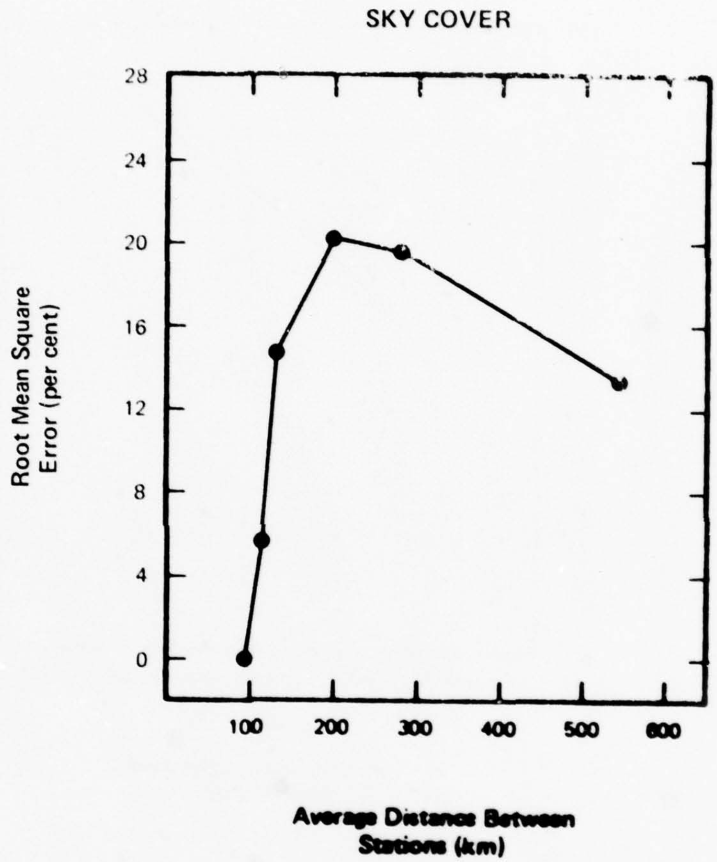


Fig. 4.6 Sky Cover RMSE vs. Station Density

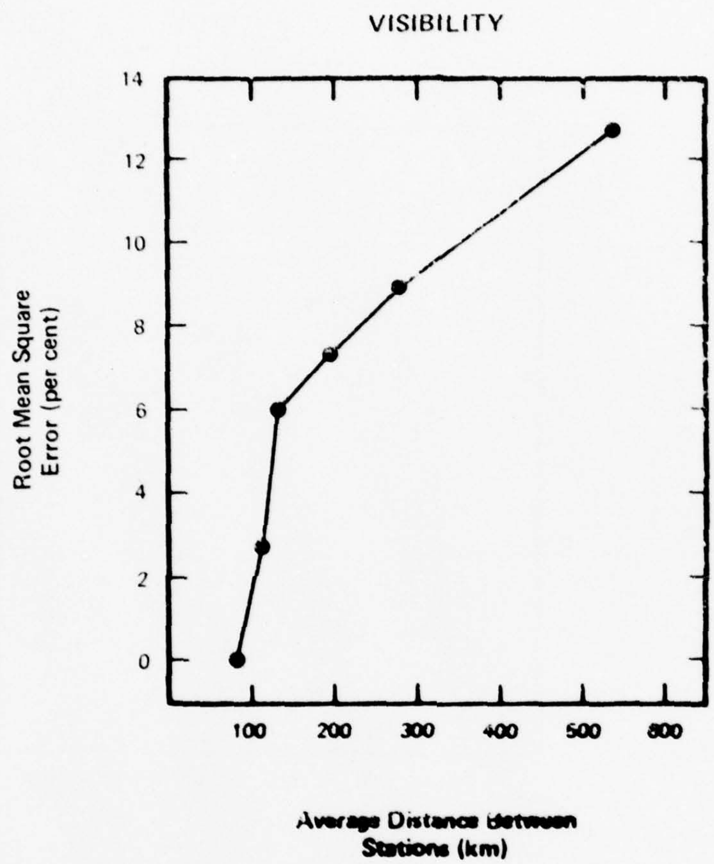


Fig. 4.7 Visibility RMSE vs. Station Density

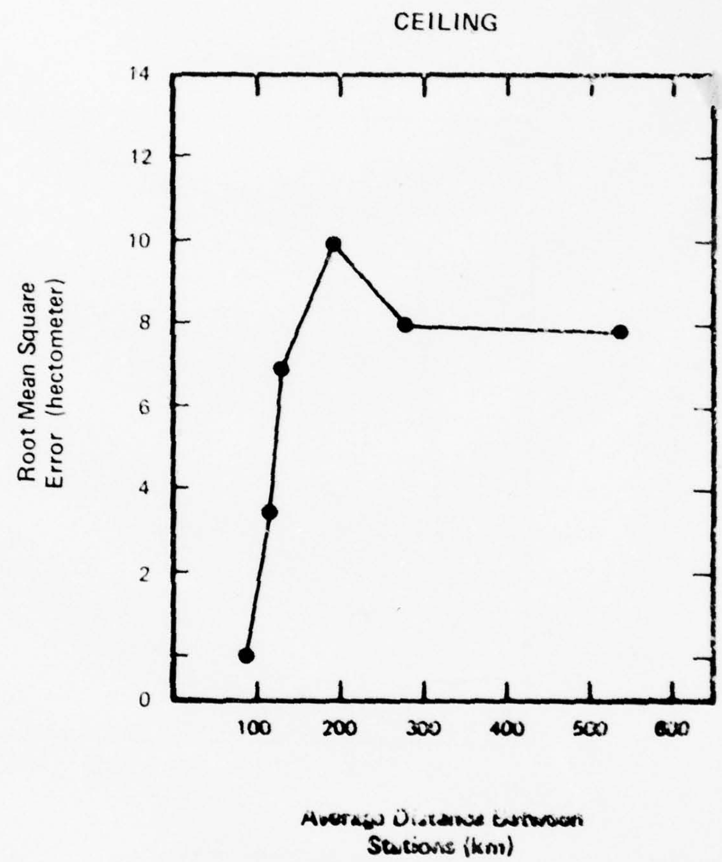


Fig. 4.8 Ceiling RMSE vs. Station Density

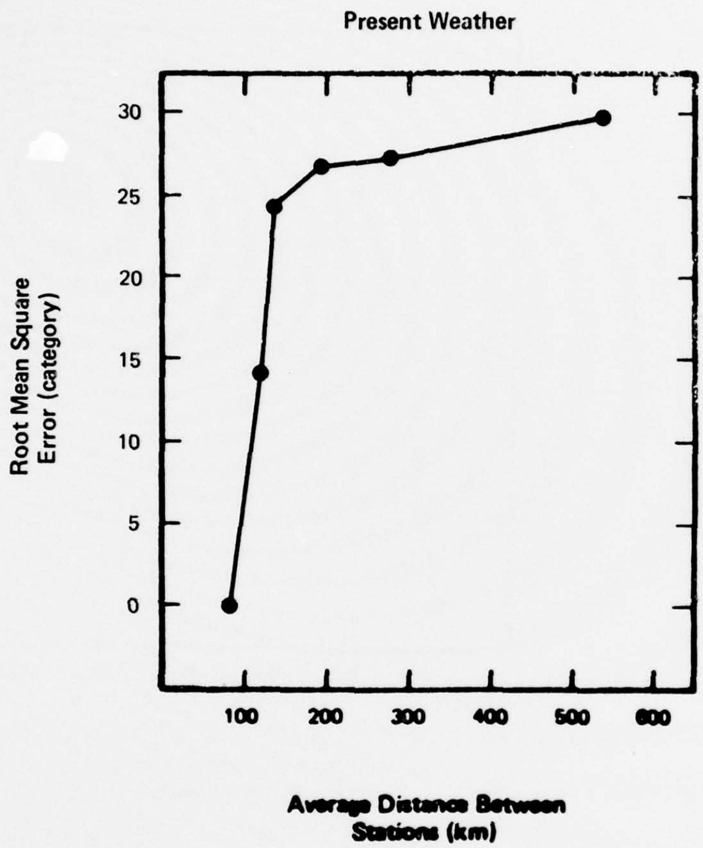


Fig. 4.9 Present Weather vs. Station Density

4.3 SILENT AREA ANALYSES

All observing stations east of a north-south line bisecting the 900 km square window-border region were eliminated from the data base to generate a silent area typical of what could be expected under battlefield conditions. Data from stations west of the demarcation line were used to construct an analysis for each of the 400 grid points contained within the inner 500 km square that encompasses the state of Alabama. The verification map was made from CTAS analysis using all data stations for the entire 900 km square.

Each grid point error was computed for both the silent area, as well as the data area for sky cover, base of the lowest cloud, and visibility. These grid point errors are shown in Figures 4.10 to 4.12 for discrete error categories shown in the lower right hand portion of the figure. The X sign was used to indicate grid points where an analysis was not possible. Notice that the missing grid point analyses are at the same locations regardless of the meteorological parameter. By referring back to the silent area station distribution shown in Figure 2.18, it can be seen that in the southern part of the map, the nearest stations are considerable distances west of the north-south demarcation line. Influence of this station distribution is shown by more missing

0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	3	X	X
0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	3	X	X
0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	3	X	X
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	3	X	X
0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	X	X	X
0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	X	X	X
0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	X	X	X
0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	X	X	X
0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	X	X	X
0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	X	X	X
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	X	X	X
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	X	X	X
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	X	X	X
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	X	X	X
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	X	X	X
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	X	X	X	X	X
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	X	X	X	X	X
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	X	X	X	X	X
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	X	X	X	X	X
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	X	X	X	X	X

← Data Area —+— Silent Area →

0 = 0 to 10%
1 = 11 to 30%
2 = 31 to 60%
3 = Greater than 60%
X = missing

Figure 4.10 Silent Area Grid Point Error Values For Sky Cover (Percent)

0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	2	X	X
0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	2	X	X
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	X	X
0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	4	X	X
0	0	0	0	0	0	0	0	0	0	1	1	2	2	2	2	2	X	X	X
1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	2	2	X	X	X
1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	2	X	X	X
1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	X	X	X
1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	X	X	X
0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	X	X	X
0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	X	X	X
0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	2	1	X	X	X
0	0	0	0	0	0	1	1	1	1	1	1	1	1	2	2	2	X	X	X
0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	2	2	X	X	X
0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	2	2	X	X	X
0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	X	X	X	X	X
0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	X	X	X	X	X
0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	X	X	X	X	X
0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	X	X	X	X	X
0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	X	X	X	X	X

← Data Area — | — Silent Area →

0 = 0 km
1 = 0.1 to 0.9 km
2 = 1.0 to 2.0 km
3 = 2.1 to 3.0 km
4 = 3.1 to 4.0 km
X = missing

Figure 4.11 Silent Area Grid Point Error Values For Base of Lowest Cloud (Kilometers)

0	0	0	0	0	0	0	0	0	0	0	0	3	3	3	3	3	3	X	X
0	0	0	0	0	0	0	0	0	0	0	0	3	3	3	3	3	3	X	X
0	0	0	0	0	0	0	0	0	0	0	0	4	4	4	4	4	3	X	X
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	4	4	X	X
0	0	0	0	0	0	0	0	0	0	2	2	3	3	3	3	4	X	X	X
0	0	0	0	0	0	0	0	0	0	0	3	2	2	2	3	3	X	X	X
0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3	3	X	X	X
0	0	0	0	0	0	0	0	0	0	0	3	2	2	2	3	3	X	X	X
0	0	0	0	0	0	0	0	0	0	0	3	3	3	3	3	3	X	X	X
0	0	0	0	0	0	0	0	0	0	1	1	3	2	2	2	3	X	X	X
0	0	0	0	0	0	0	0	1	2	2	2	2	1	0	0	0	X	X	X
0	0	0	0	0	0	0	0	2	2	2	2	2	1	0	0	0	X	X	X
0	0	0	0	0	0	0	1	2	2	2	2	2	1	0	0	0	X	X	X
0	0	0	0	0	0	1	1	2	2	2	2	2	1	1	0	0	X	X	X
0	0	0	0	0	1	2	2	3	2	2	1	1	0	0	0	3	X	X	X
0	0	0	0	0	1	2	2	3	3	2	0	2	2	2	X	X	X	X	X
0	0	0	0	1	1	2	3	3	2	2	0	2	2	2	X	X	X	X	X
0	0	0	0	0	0	2	3	3	2	2	0	2	2	2	X	X	X	X	X
0	0	0	0	0	0	0	0	0	0	1	0	2	2	2	X	X	X	X	X
0	0	0	0	0	0	0	0	0	0	1	0	0	2	2	X	X	X	X	X

← Data Area — Silent Area →

0 = 0 to 0.5 km
1 = 0.6 to 1.0 km
2 = 1.1 to 2.0 km
3 = 2.1 to 10.0 km
4 = Greater than 10 km
X = missing

Figure 4.12 Silent Area Grid Point Error Values For Visibility (Kilometers)

grid point analyses in the southeast portion of Figures 4.10 to 4.12.

The maximum number of search squares allowable for this study was eight. Increasing the number of search squares to ten for the northeast sector and to thirteen for the southeast sector of the map would have forced an analysis at all grid points so that there would be no missing analysis points. The CFAS search control parameter can always be set as the greatest distance between a grid point and the nearest observation to insure no missing grid point analyses even in silent areas. The further a grid point is removed from a data point and the smaller the scale of the phenomena the more questionable the analysis. On the other hand, some have argued that such an analysis expanded to include climatological and forecast or extrapolated information would produce more reliable estimates than a pilot's guess of silent area conditions. The CFAS can accept forecast information as data inputs to its objective analysis. The CFAS does not presently have, however, the capability to perform its own trend or forecast analysis for extrapolating information into a silent area.

It can be seen from Figure 4.10 that the CFAS sky cover analysis not only has no errors in the data region but also does remarkably well in the silent area. It is interesting to note that neither statement can be made concerning analyses of mesoscale features

associated with visibility or base of the lowest cloud, shown in 4.12 and 4.11, respectively. In both of the latter cases, lack of stations in the southern part of the data area adversely effects analyses in both the silent and data area. It can be stated that, in general, for all three weather variables, results deteriorate as distance increases into the silent area. In fact, the largest visibility error exceeds 10 km and the largest error in the lowest cloud base exceeds 3 km. The importance of having some observations, especially of mesoscale features, can not be overemphasized, and, as discussed previously, reconnaissance or satellite reports would be valuable additions to silent area analyses. This is further emphasized by the "goodness of fit" results shown in Table 4.3. In this table the correlation coefficient,percent of missing grid point analyses, and RMSE are tabulated for nine meteorological variable analyses completed within the 500 km square region that includes half a data rich and half a silent area. A maximum of 18.5% of the grid points were missing an analysis for the first cloud layer, whereas all other variables had a 16.5% missing data analysis rate. The correlation coefficients and RMSE values were the lowest and highest, respectively, for such weather variables as ceiling and layered cloud cover. A correlation coefficient of only 0.31 was obtained for

TABLE 4.3 Silent Area Goodness of Fit Values

	Correlation Coefficient	% Missing Grid Points	RMSE
Sky Cover	.88	16.5	14%
Ceiling	.55	16.5	.96 km
Visibility	.94	16.5	2.9 km
Present Weather	.94	16.5	9 category units
Cloud Layer 1	.31	18.5	23%
Cloud Layer 2	.46	16.7	25%
Cloud Layer 3	.51	16.5	24%
Cloud Layer 4	.61	16.5	31%
Cloud Layer 5	.58	16.5	38%
Cloud Layer 6	.77	16.5	28%
Cloud Layer 7	.91	16.5	15%
Cloud Layer 8	.79	16.5	23%
Cloud Layer 9	.73	16.5	25%

the percent cloud cover in the first layer which extends from the surface to 45 meters above ground level (AGL). The correlation improved for percent cloud cover within the second layer (from 45 to 91 meters AGL) and essentially continued to improve for each successively higher layer. Thus, the greatest difficulty in analyzing percent cloud cover within particular layers occurred in layers closest to the ground. It is precisely in this region that there were fragmented clouds and low scud which drift rapidly into and out of sight of the observer and present the worst objective analysis results.

5 ARMY AVIATION WEATHER DEMONSTRATION MATERIAL

5.1 MAP DISCUSSION OF RESULTS

The purpose of this section is to demonstrate a variety of capabilities that are possible using computer applications to Army aviation weather problems. In order to appreciate some of the problems, a typical teletype weather report is reproduced in Fig. 5.1. The problem that a pilot encounters in attempting to acquaint himself with the current weather is compounded by the fact that weather information is coded primarily for meteorologists, requires a knowledge of local station call letters and/or numbers, is filed on clip boards according to FAA transmission circuit number, or appears on difficult to read facsimile weather charts. In order for a pilot to obtain the latest weather significant to his flight it is necessary for him to screen or sift through all special weather observations to obtain and decifer those important to his mission. Often on urgent missions and in the hustle of immediate operations it is not possible for a pilot to maintain proficiency in his primary function while maintaining cognizance of weather restrictions on his performance.

The present Army weather support system evolved from extension of the labor intensive concept of having trained meteorologists

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AL 071104

MISSING
ANB CLR 7 227/40/30/0503/019
BHM CLR 7 238/34/31/3607/023
DHN E40 BKN 5F 197/49/44/3212/012→DHN↘3/6 3/7
HSV CLR 15 244/35/25/3203/024
MGM CLR 7 228/42/36/3408/020→MGM↘3/11
MOB CLR 15 231/41/37/3408/022
MSL CLR 10 249/34/31/2904/026
TCL CLR 7 237/39/34/3604/025


G2


TN 071105
BNA CLR 12 240/33/29/2504/024→BNA↘12/8 3/1
CHA CLR 12 230/37/28/2103/026
CSV CLR 7 222/33/23/3605/017→CSV↘2/3
DYR
MEM CLR 12 262/36/27/1403/038→MEM↘11/3 1/5 1/10 1/16 2/19 3/5
MKL CLR 10 259/32/29/0000/029
TRI 70 SCT 10 202/36/24/2504/011
TYS CLR 15 222/40/26/3304/013→TYS↘3/3


44


MS 071106
GLH FINO
GWO CLR 12 261/33/32/0000/030
JAN CLR 8 260/33/32/3404/030 →JAN↘2/10
MCB CLR 10 257/39/34/0104/029→MCB↘3/12
MEI CLR 5GF 255/35/31/3504/023


60


SC 071106

MISSING
AND SP 8 SCT M10 OVC 3R-F 167/47/46/0106/003/ RB ET35/ PCPN VRY LGT
CAE M6 BKN 19 OVC 4F 163/51/47/3412/031/RE35 CIG RGD
CHS SP M5 OVC 5L-F 142/52/50/3606/994/CIG RGD
CRE
FLO M40VC 7R- 132/49/49/3509/992 RB35→FLO↘1/1 2/16
GSP M37 OVC 12 172/45/44/2106/004/RE15
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Fig. 5.1 Typically Difficult to Read Teletype Weather Report

providing pilot weather briefings. The time period of the 1980's and the expected available trained personnel and support logistics suggest that an automated method of providing weather information can not only provide better, up to date, and operationally tailored information, but can do so in a manner that greatly reduces manpower while increasing efficiency within a battlefield environment.

A pilot controlled and operated computer weather system can provide upon his command not only the latest update of weather information tailored to his needs but can also provide the past sequence of events and, if necessary, can provide a short-time projection of future weather events.

For any geographical or weather analysis region, the computer can provide such operationally important features as the topography and geopolitical boundaries upon which an analysis can be made. For our purposes, Fig. 5.2 shows these features for the Alabama region where we will focus our attention for this study to demonstrate some of the products that are possible to support Army operations.

Before proceeding to discuss the many figures that describe the computers capability to present time series of weather events or many weather events for one time period, it should be mentioned that

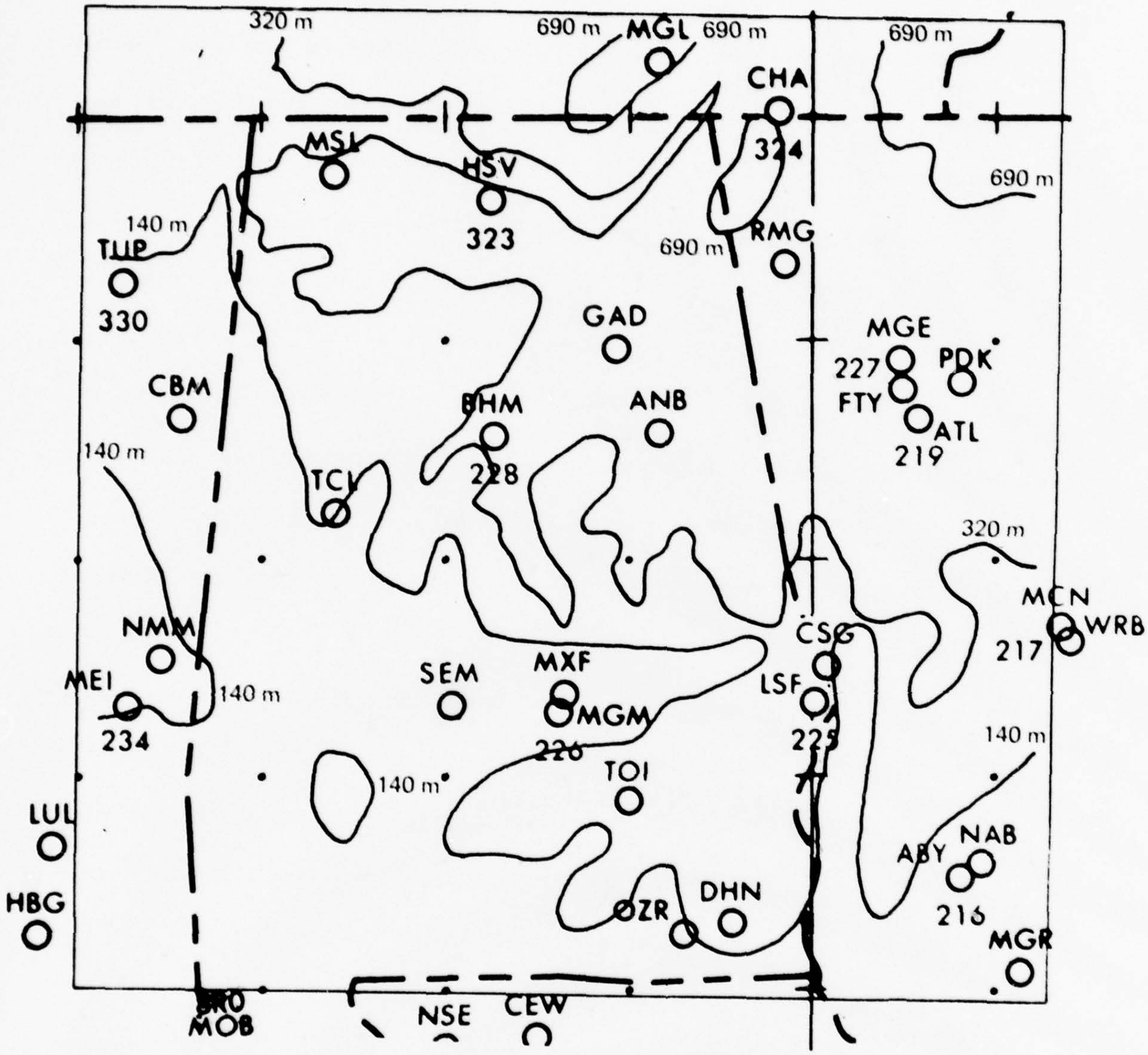


Fig. 5.2 Topography and Geo-Political Features

this is a very limited sample of what is possible. It should also be emphasized that in order for the maximum benefit to be achieved from automated weather applications to Army operations, it is necessary that both the Army operational and meteorological community identify their mutual problems, assign priorities, and work collectively to attain defined goals.

We have selected a time series of meteorological events that would be of interest to aviation personnel. Computer analyses were made at odd times to be more characteristic of pilots interrogating the computer terminal on a random basis. The time series analyses are given for five meteorological variables. Figs. 5.3 to 5.7 present computer analyses of per cent sky cover for five separate times beginning 2130Z 26 February 1977 and ending 0640Z 27 February 1977. Figs. 5.8 to 5.11 present the height of the lowest cloud base beginning 0040Z and ending 0640Z 27 February 1977. Figs. 5.12 to 5.15 present the ceiling height and Figs. 5.16 to 5.19 depict the horizontal visibility at the surface for the same time interval as the lowest cloud base analyses. Fig. 5.20 to 5.24 also cover the same time interval, plus an additional analysis of present weather conditions at 0720Z 27 February 1977. A color code was used for all the analyses to depict

categories of weather conditions. In all cases, red was used to indicate the worst aviation weather conditions, then came yellow, green, and blue, in that order, with white areas representing the best flight weather.

Sky cover analysis for 2130Z 26 February in Fig. 5.3 shows the series begins with most of the area having clear or partly cloudy skies. Only in the southwest and northwest corners do broken clouds exist. Four hours later, Fig. 5.4, spotted regions on the map have overcast conditions but as time progresses, the entire area, as seen in Fig. 5.7, becomes engulfed by nearly an unbroken solid mass of clouds.

The lowest cloud base analysis series shows the detail character that is attainable with the computer system. This is one parameter that is difficult to obtain a mental picture of what exists by reading teletype reports. It is also a parameter that is not routinely analyzed and transmitted on the facsimile circuit. Yet it is a parameter that has value, especially to helicopter pilots that do not have sophisticated instruments to fly in clouds. Notice in Fig. 5.8, there are two small regions where the lowest cloud bases are below 0.15 km. The corresponding sky cover map, Fig. 5.4, shows overcast skies for these same areas but the ceiling map, Fig. 5.12, shows the overcast skies are above 1.2 km. A corresponding map, Fig. 5.16, shows

visibility exceeds 4 km for the same geographical location as those low clouds while the present weather map, Fig. 5.20, shows fair for one and rain for the other location. Thus, by looking at several of these maps for the same time period one can obtain a good mental picture of weather conditions prevailing at a given location. This feature will be demonstrated more in the later discussion on Figs. 5.25 to 5.33. As far as the lowest cloud base map series is concerned, the patchy nature and detail of this variable is clearly illustrated along with its rapid time changes as shown in Fig. 5.8 to 5.11. Field Army flights are frequent but usually less than an hour in duration. Having a system that keeps a pilot "weatherwise" of the latest details would prove valuable in planning and executing a mission.

Categories desired for displaying an analyzed variable can be inputted by the user to provide flexibility in satisfying requirements of different missions. Since most Army flights are flown at altitudes below 1.2 km, the ceiling and lowest cloud height categories were chosen to provide analysis resolution in the lowest layers. A cloud ceiling is only reported for those clouds that cover a sufficient portion of the sky to constitute either broken or overcast conditions. For this reason considerable differences exist between the lowest cloud base

maps and the ceiling time series maps in Figs. 5.12 to 5.15. Very low ceilings, below 0.15 km, remain stationary in the southern part of Alabama while very low ceilings move systematically from west to east across the northern part of the state. Horizontal visibility begins the series exceeding 4 km for all but a small (25 to 50 km) portion of the map, Fig. 5.16. Only the southern part of the state experiences visibilities less than 1 km and for two different reasons. A small strip of low visibilities produced by fog remains static in the southeast corner of the state. Those low visibilities in the southwestern corner of the map, Fig. 5.19, are produced by rain from thunderstorms, as shown in Fig. 5.23. At a glance it is possible to delineate regions of high visibility and to track the movement or stagnation of visibilities within operationally defined categories.

Present weather analyses begin with a touch of snow, rain, and showers or thunderstorms, Fig. 5.20, but most of Alabama is under the influence of fair weather. Three hours later, in Fig. 5.21, the snow in the north has changed to rain, the rain in the south has stopped, thunderstorms remain in the west but begin to appear in the north ahead of the steady rain, and radiational cooling under fair skies has resulted in fog conditions in the southeast corner. An hour and half later, Fig. 5.22, the radiation fog remains, the rain returns in the south and

expands in the north, and showers and thunderstorms ring the northern rain area. After another hour and a half, Fig. 5.23, rain and showers progress southeastward and the radiation fog remains entrenched in the southeast corner. Only 40 minutes later, Fig. 5.24, a 200 km wide band of thunderstorms exists about a northeast-southwest axis extending from CHA (Chattanooga, TN) to MOB (Mobile, AL) while the southeast radiation fog continues to persist. Computer analyses of the latest present weather phenomena should find great acceptance by pilots and prove to be very beneficial.

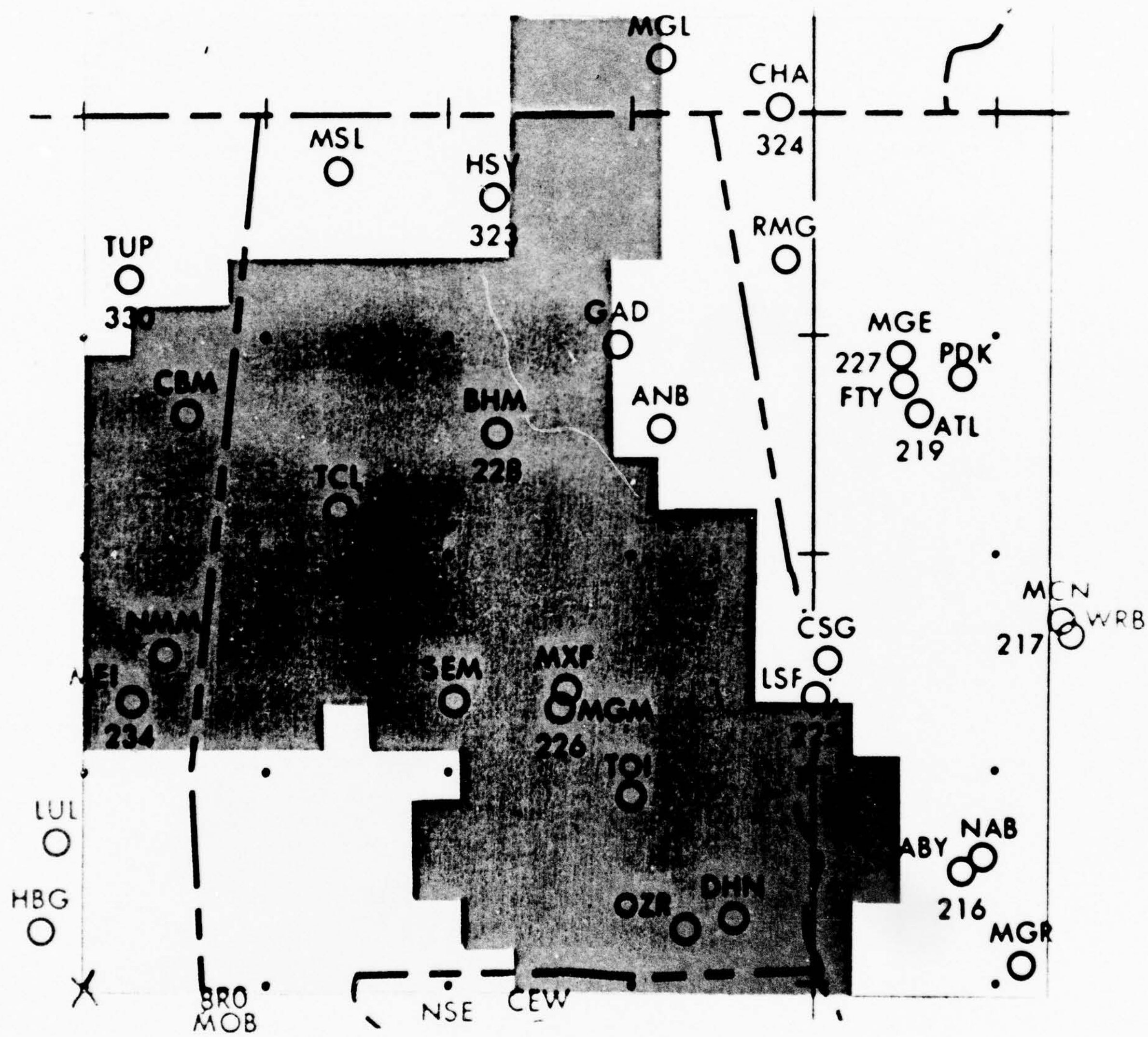
At any one instant in time, a pilot may wish to view all weather variables that exist within his area of interest. Such a set is provided in Figs. 5.25 to 5.33 for nine weather parameters. The entire state of Alabama has overcast skies, Fig. 5.25, with a good portion of it containing low clouds, Fig. 5.26, whose bases are less than 0.3 km. Although all of Alabama has a cloud ceiling, only the northern and southern portions have ceilings below 0.6 km, Fig. 5.27. It is interesting to note that only southern portions experience low visibilities, Fig. 5.28, produced by fog in the east, rain in the midsection, and showers in the western part of the state, Fig. 5.29.

A pilot may wish to have information tailored to his flight altitude. One such output is presented to show the extent that a

particular flight layer is obscured by clouds. Figs. 5.30, 5.31, 5.32, and 5.33 display the per cent cloud cover as overcast, broken, partly cloudy, or clear for the flight layers from surface to 45 m, 45 to 91 m, 91 to 183 m, and 183 to 305 m AGL, respectively. Notice the detail and structure that is attainable via the computer and how a pilot can quickly assimilate his ability to maintain visual contact within each layer.

A number of other candidate computer output products include such items as:

1. severe weather tracks
2. areas below minimum ceilings and/or visibilities
3. VFR and IFR flight paths
4. vertical sections of flight plans
5. air to ground clear lines of sight
6. best flight plan for not being seen from ground
7. best flight plan for photo recon mission
8. plus many others where weather factors influence Army operations.



white CLEAR
PARTLY CLOUDY
BROKEN
OVERCAST

Fig. 5.3 Sky Cover 2130Z 26 Feb 1977 Computer Analysis

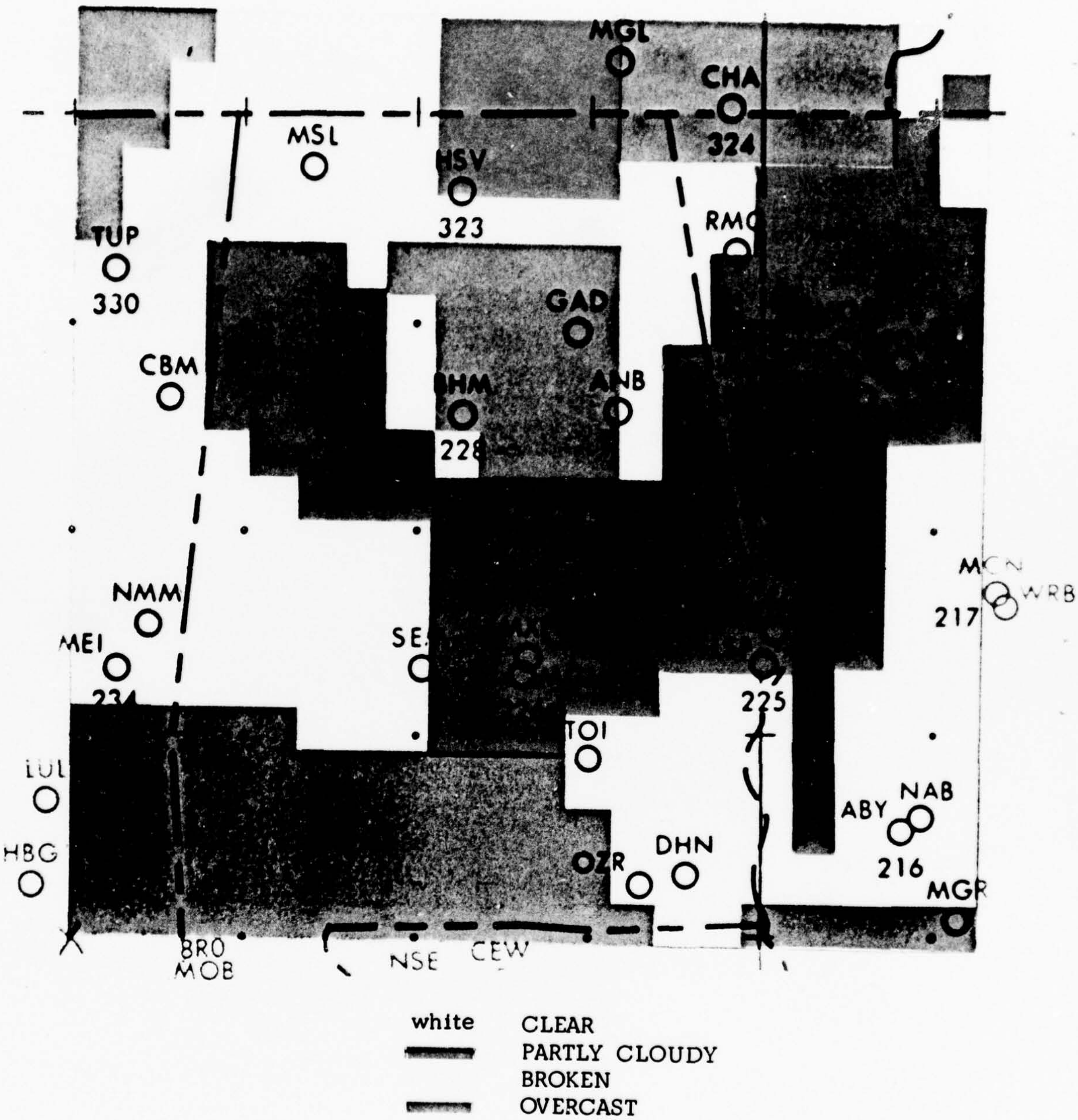
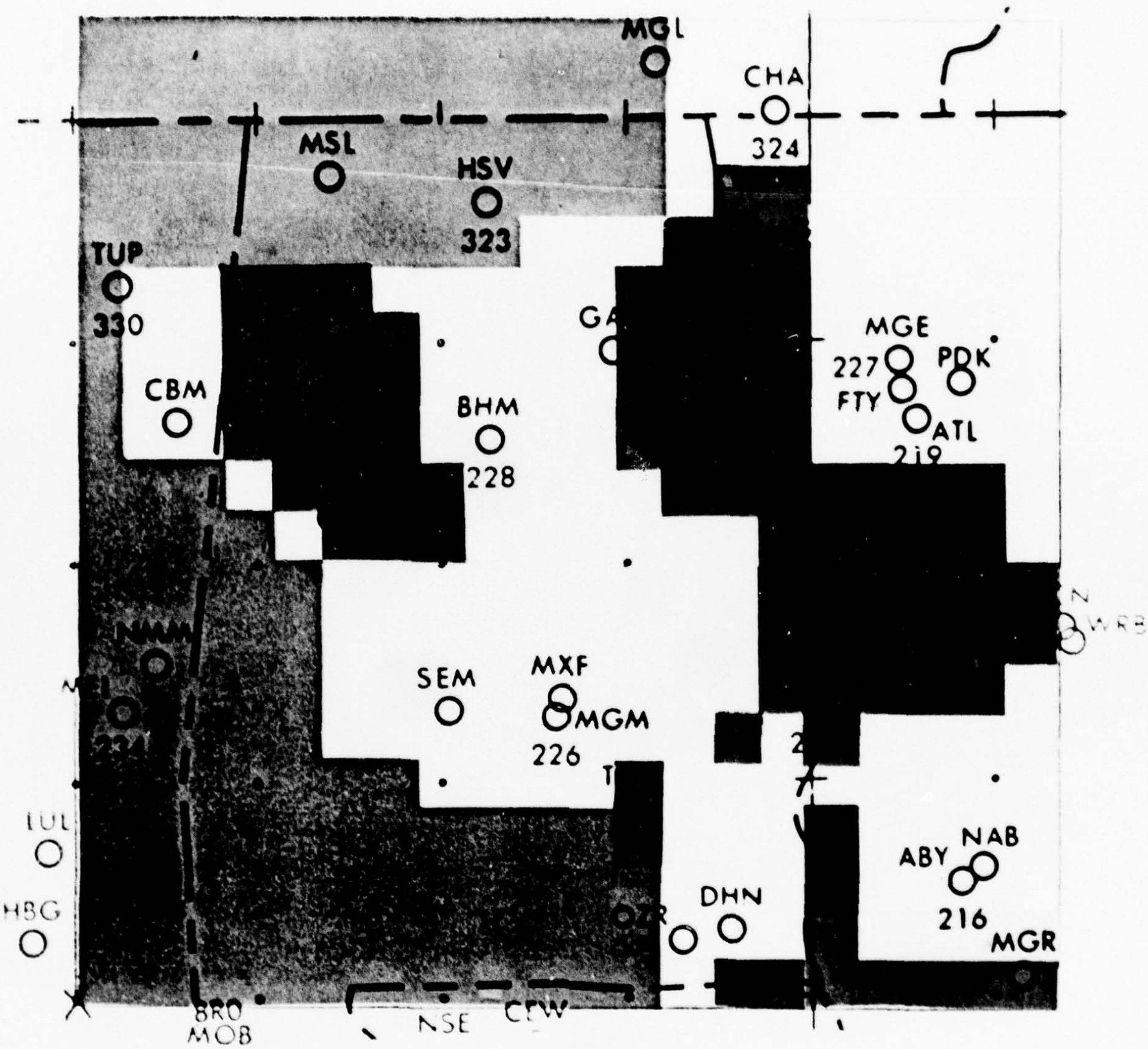


Fig. 5.4 Sky Cover 0040Z 27 Feb 1977 Computer Analysis



white CLEAR
PARTLY CLOUDY
BROKEN
OVERCAST

Fig. 5.5 Sky Cover 0340Z 27 Feb 1977 Computer Analysis

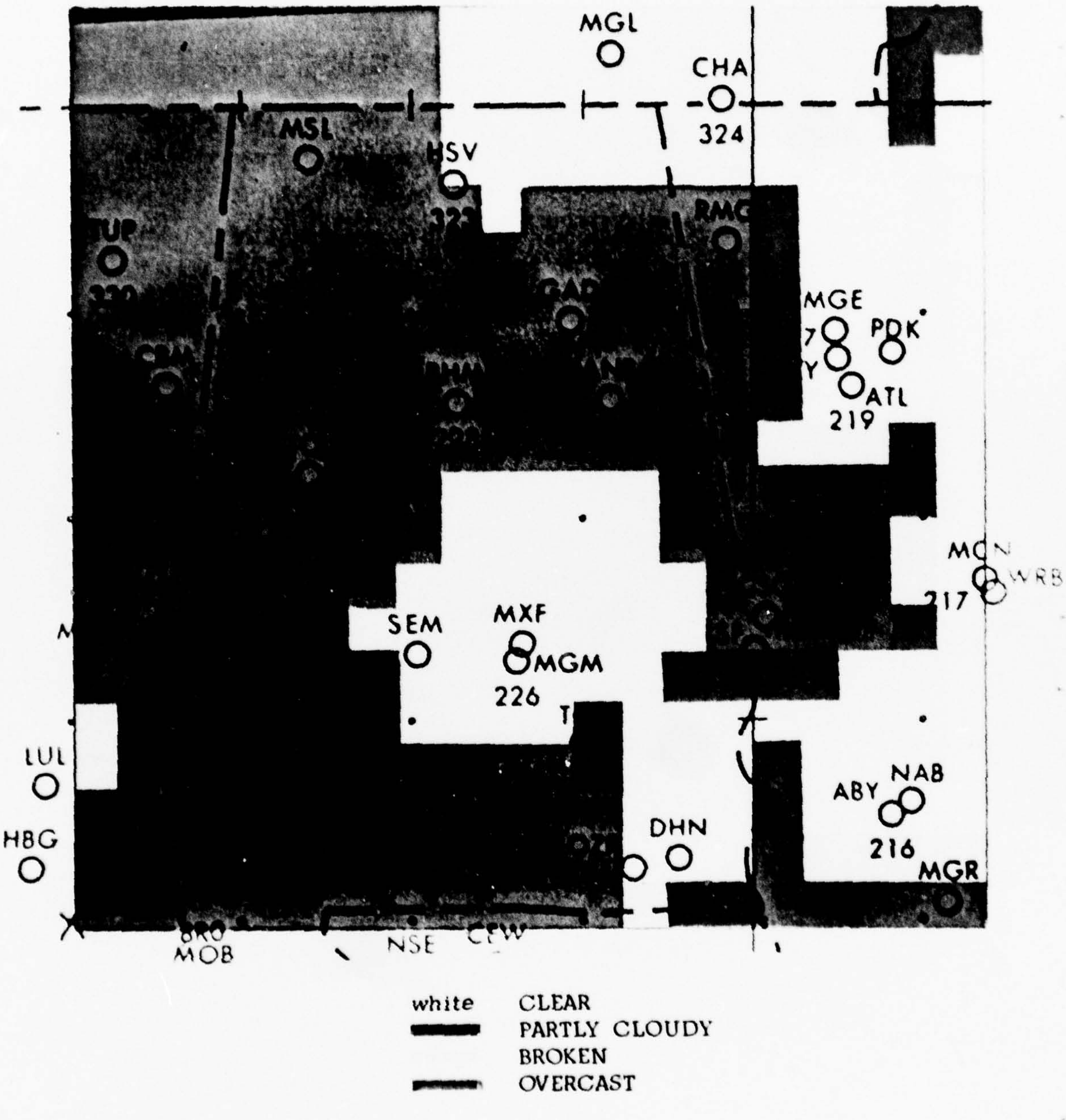
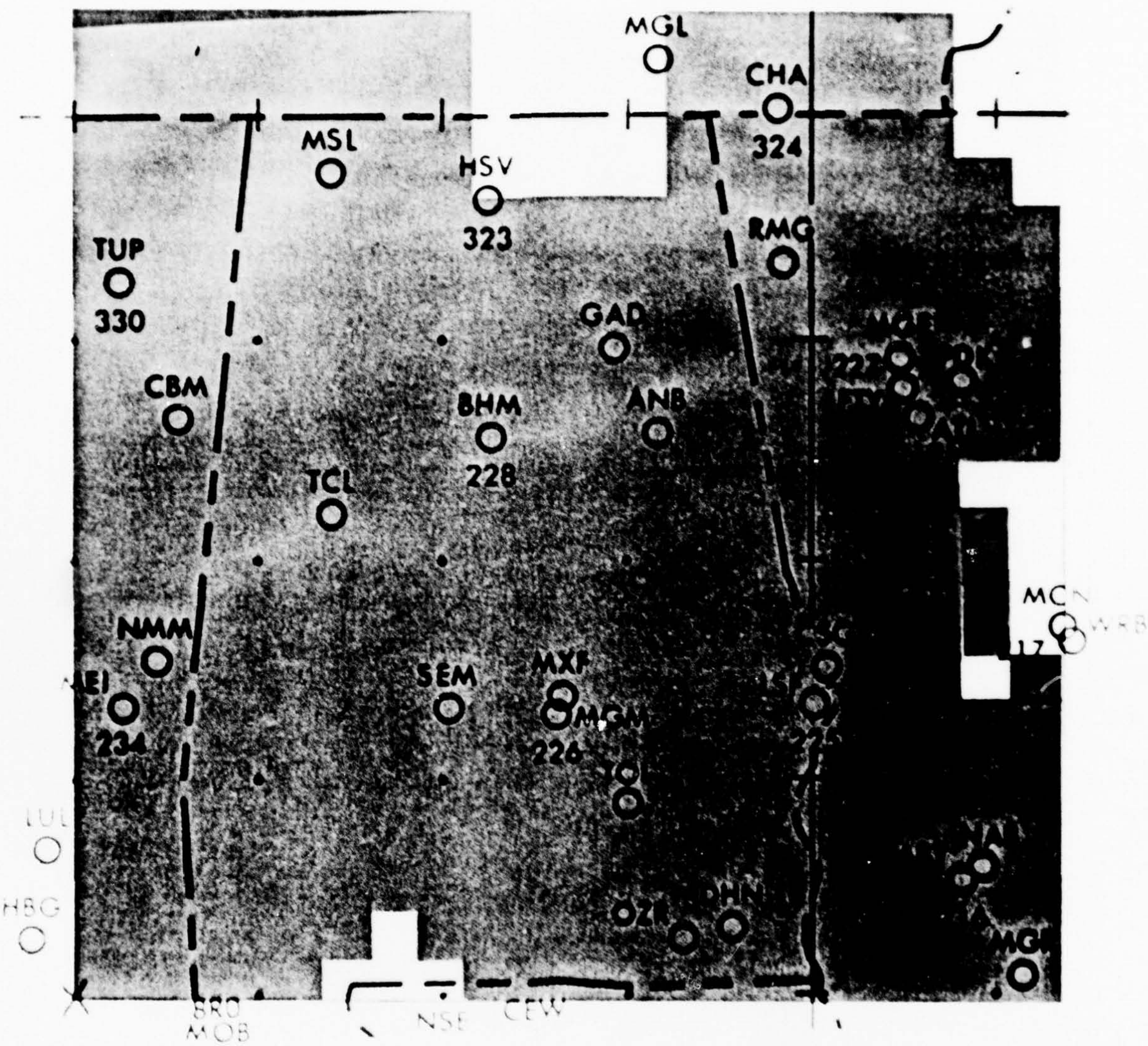
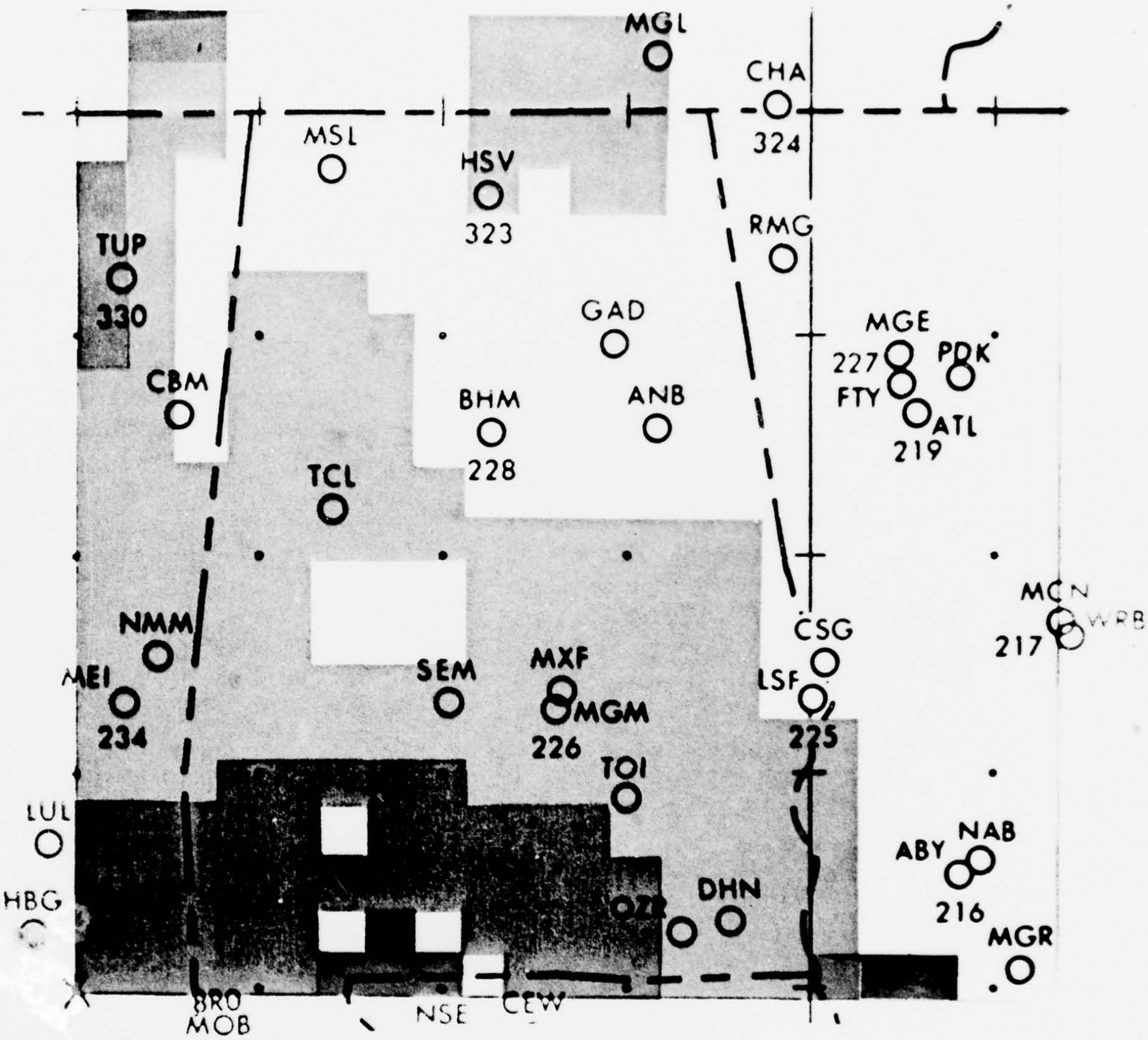


Fig. 5.6 Sky Cover 0510Z 27 Feb 1977 Computer Analysis



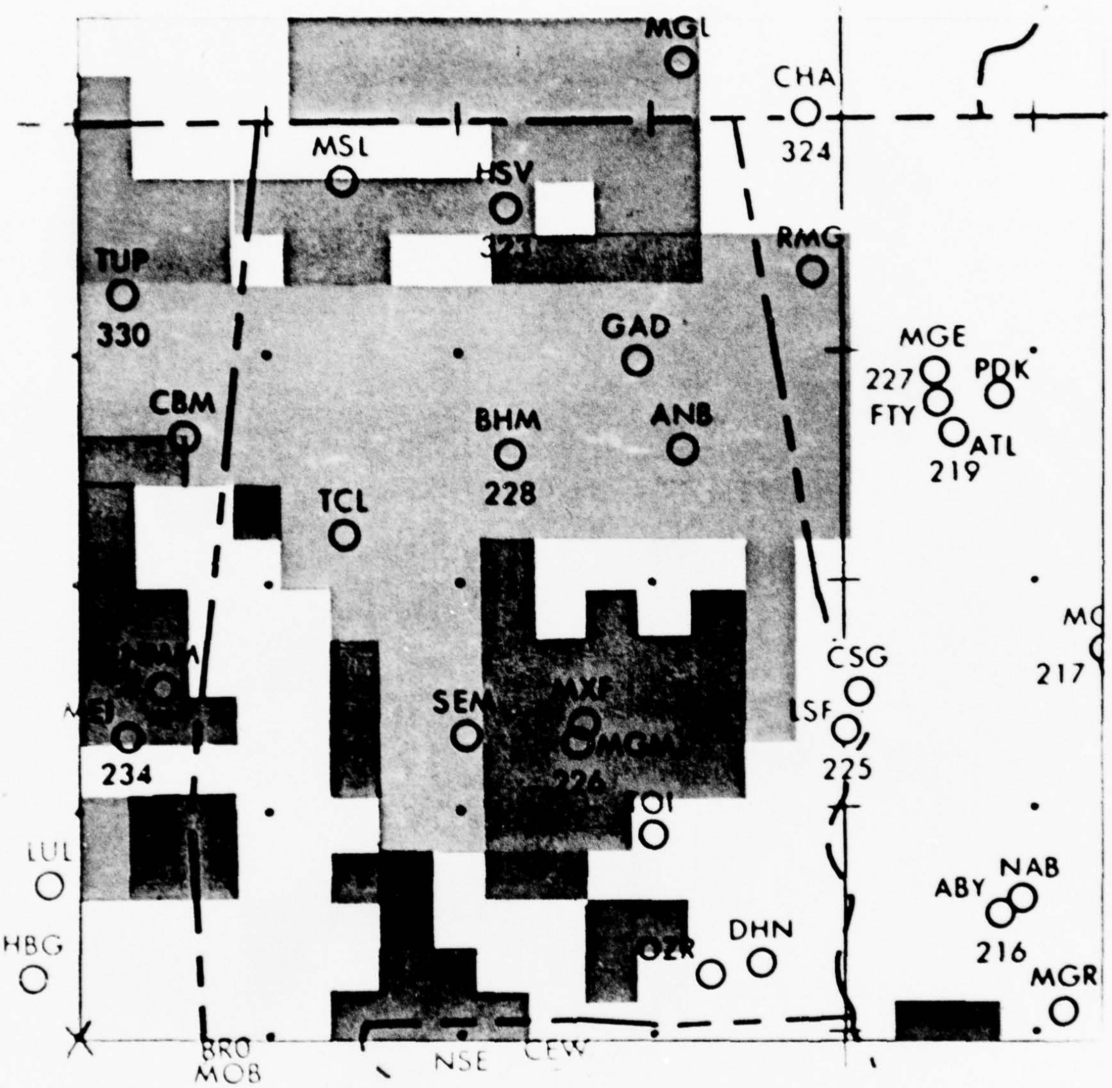
white	CLEAR
	PARTLY CLOUDY
	BROKEN
	OVERCAST

Fig. 5.7 Sky Cover 0640Z 27 Feb 1977 Computer Analysis



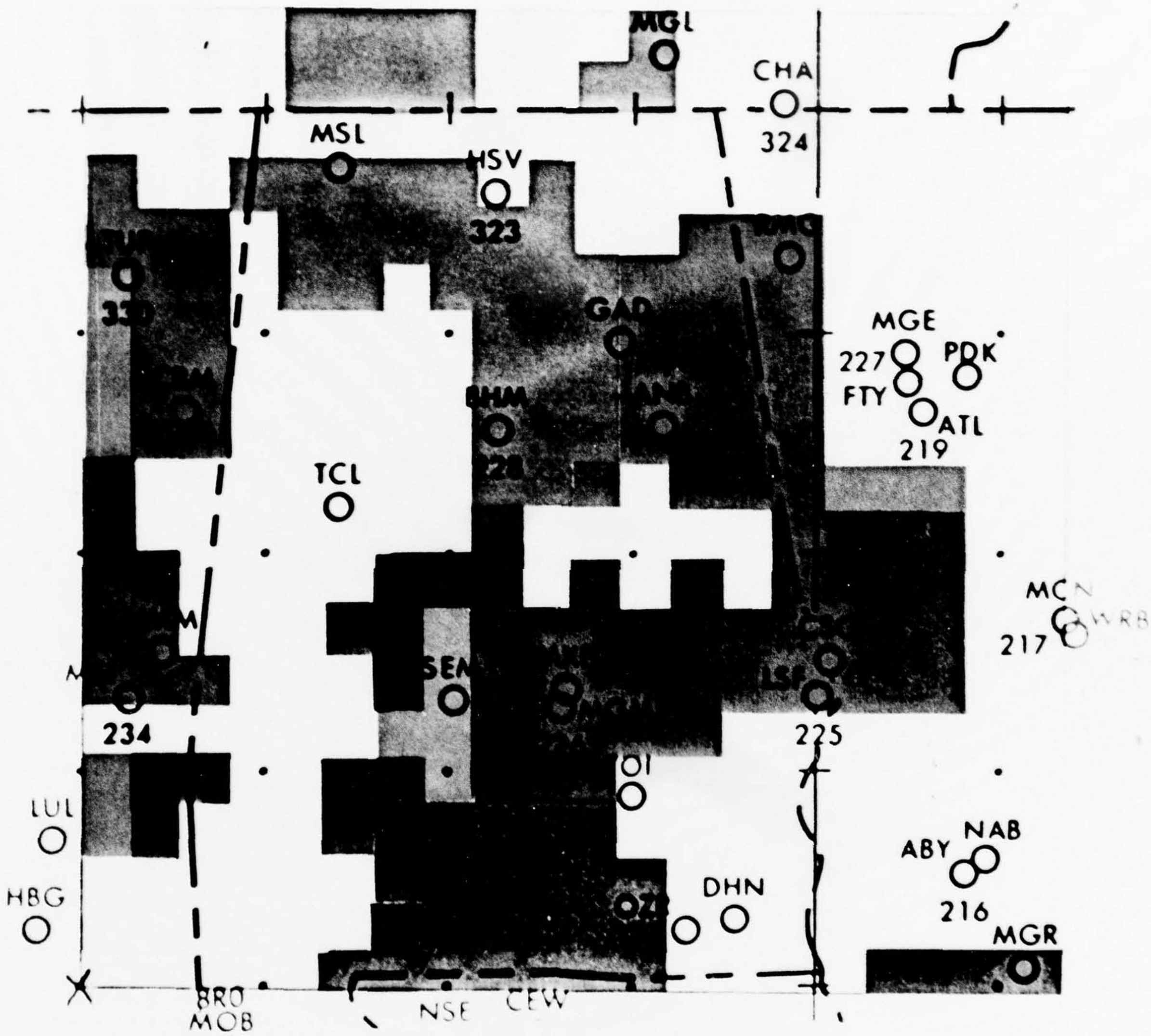
white ABOVE 1.2 km
.6 to 1.2 km
.3 to .6 km
.15 to 3 km
BELOW .15 km

Fig. 5.8 Lowest Cloud Base 0040Z 27 Feb 1977 Computer Analysis



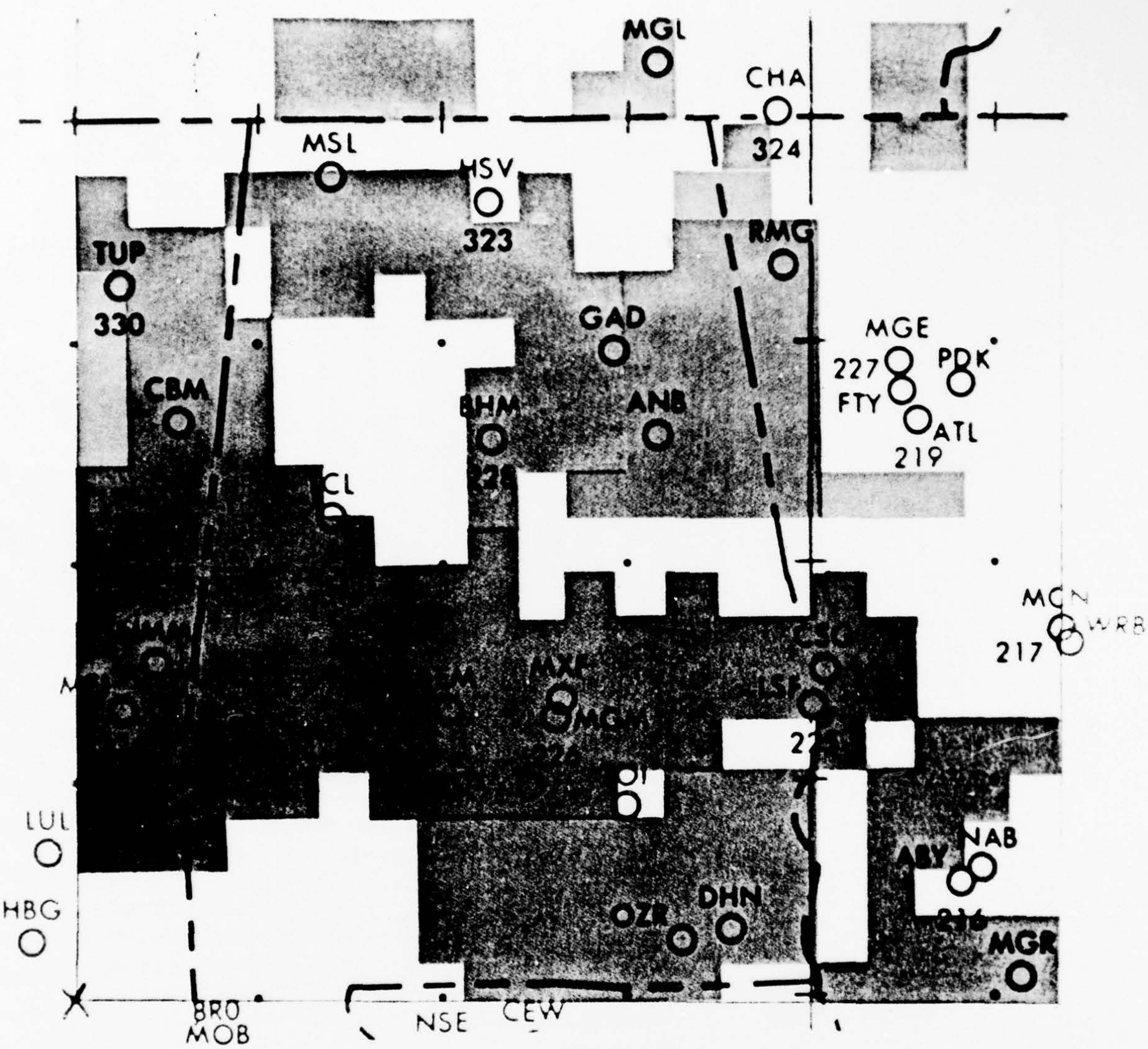
white ABOVE 1.2 km
.6 to 1.2 km
.3 to .6 km
.15 to .3 km
BELOW .15 km

Fig. 5.9 Lowest Cloud Base 0340Z 27 Feb 1977 Computer Analysis



white	ABOVE 1.2 km
	.6 to 1.2 km
	.3 to .6 km
	.15 to .3 km
	BELOW .15 km

Fig. 5.10 Lowest Cloud Base 0510Z 27 Feb 1977 Computer Analysis



white ABOVE 1.2 km
.6 to 1.2 km
.3 to .6 km
.15 to .3 km
BELOW .15 km

Fig. 5.11 Lowest Cloud Base 0640Z 27 Feb 1977 Computer Analysis

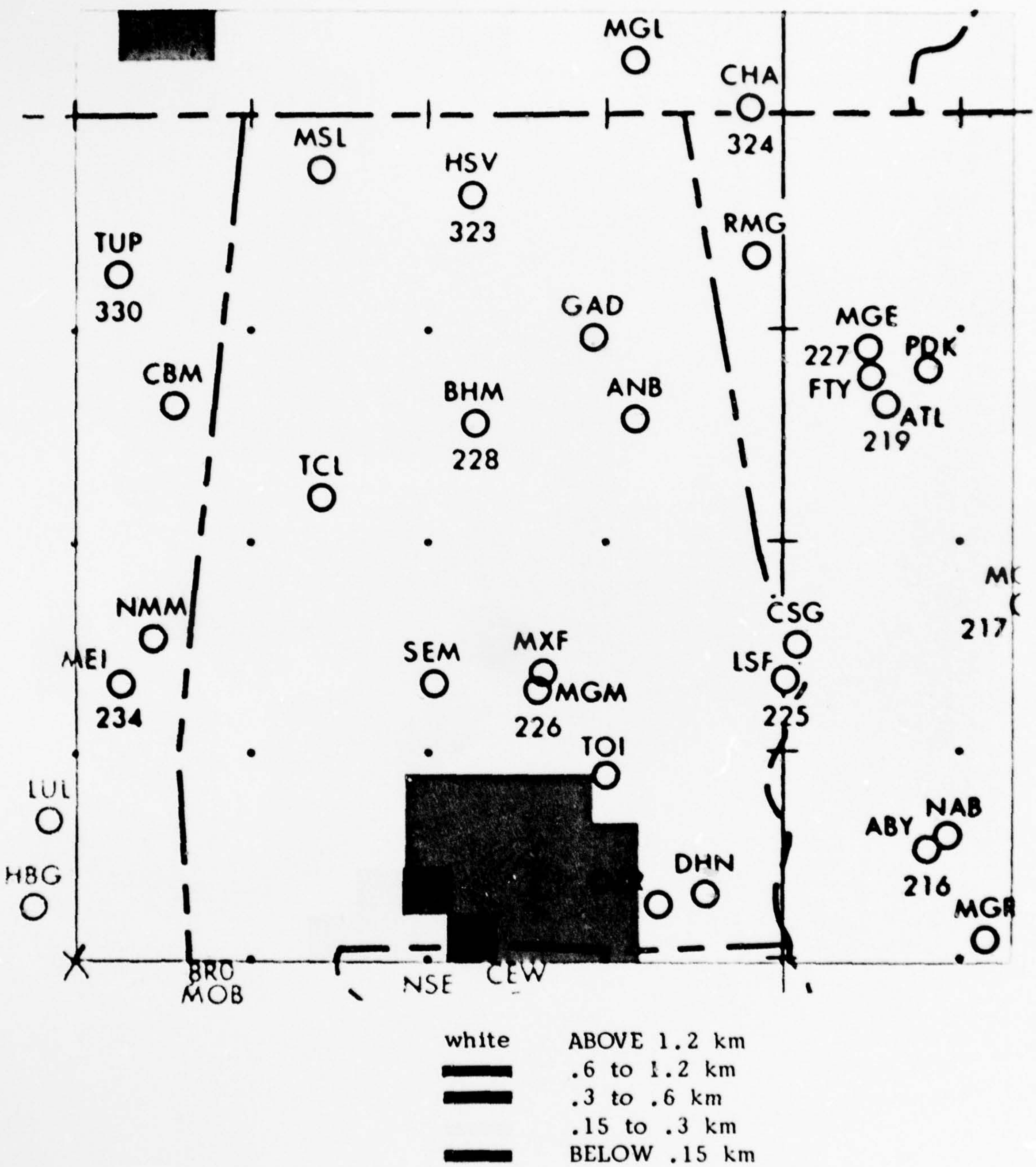
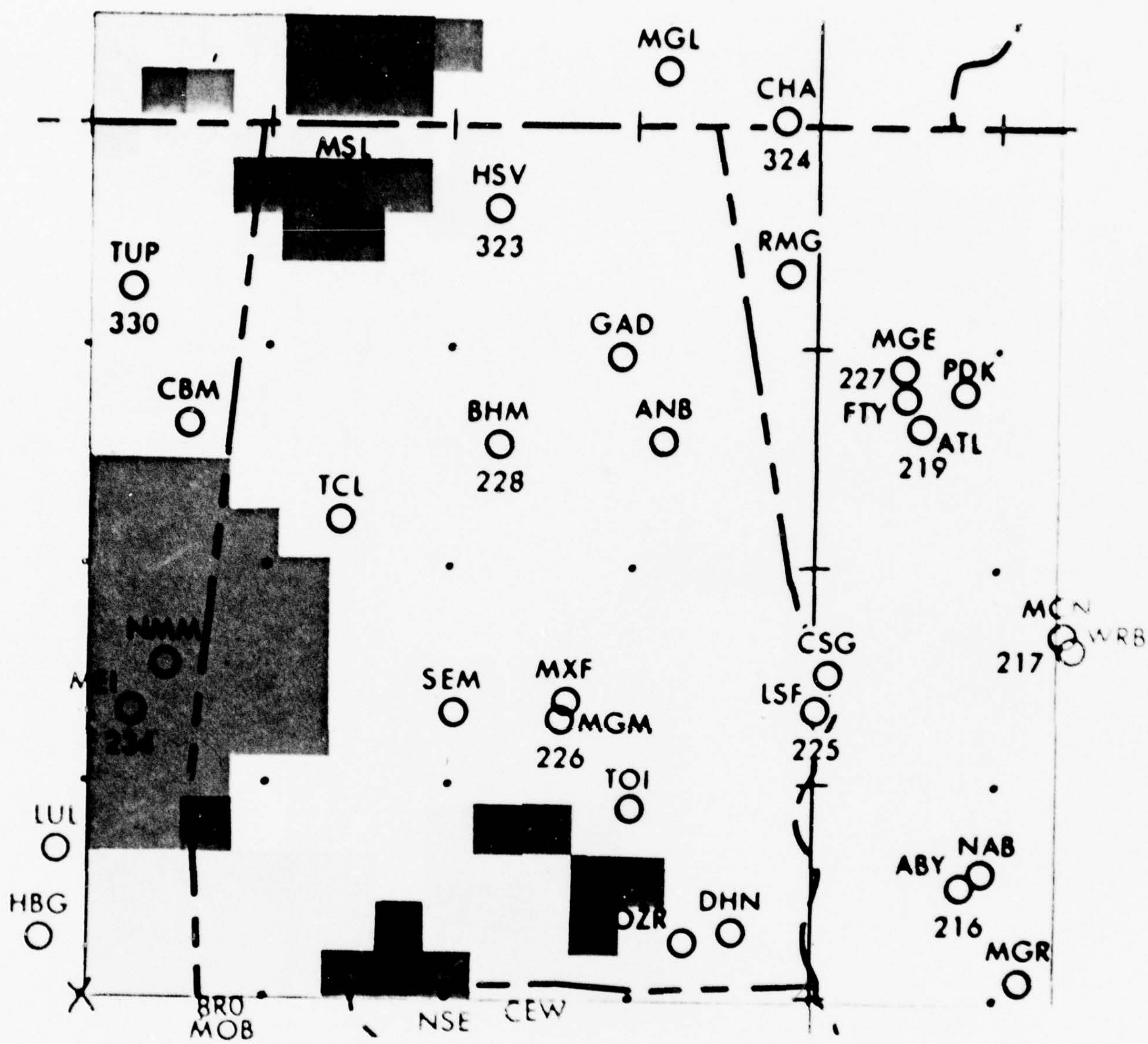


Fig. 5.12 Ceiling 0040Z 27 Feb 1977 Computer Analysis



white ABOVE 1.2 km
.6 to 1.2 km
.3 to .6 km
.15 to .3 km
BELOW .15 km

Fig. 5.13 Ceiling 0340Z 27 Feb 1977 Computer Analysis

white	ABOVE 1.2 km
	.6 to 1.2 km
	.3 to .6 km
	.15 to .3 km
	BELOW .15 km

Fig. 5.14 Ceiling 0510Z 27 Feb 1977 Computer Analysis

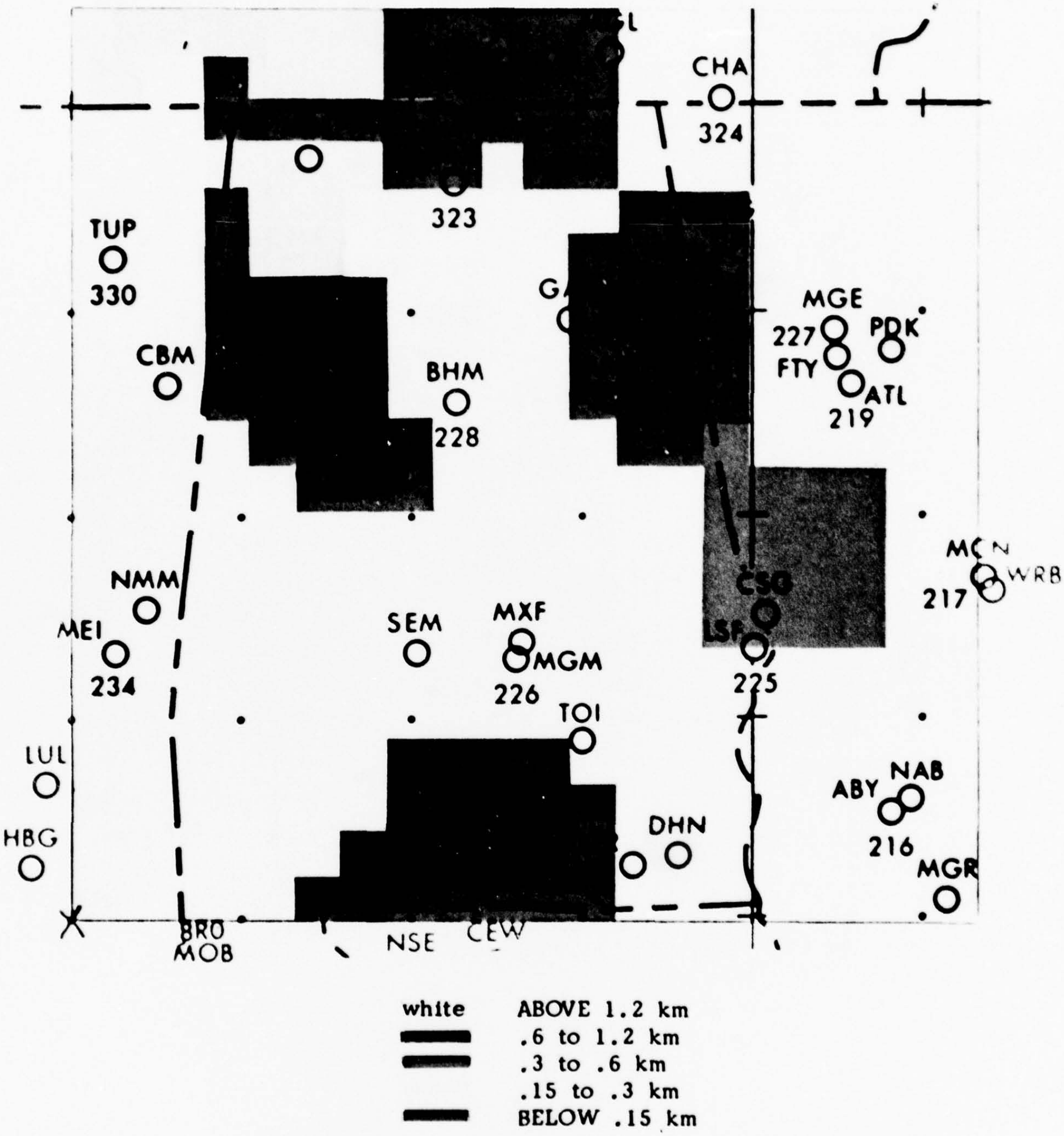


Fig. 5.15 Ceiling 0640Z 27 Feb 1977 Computer Analysis

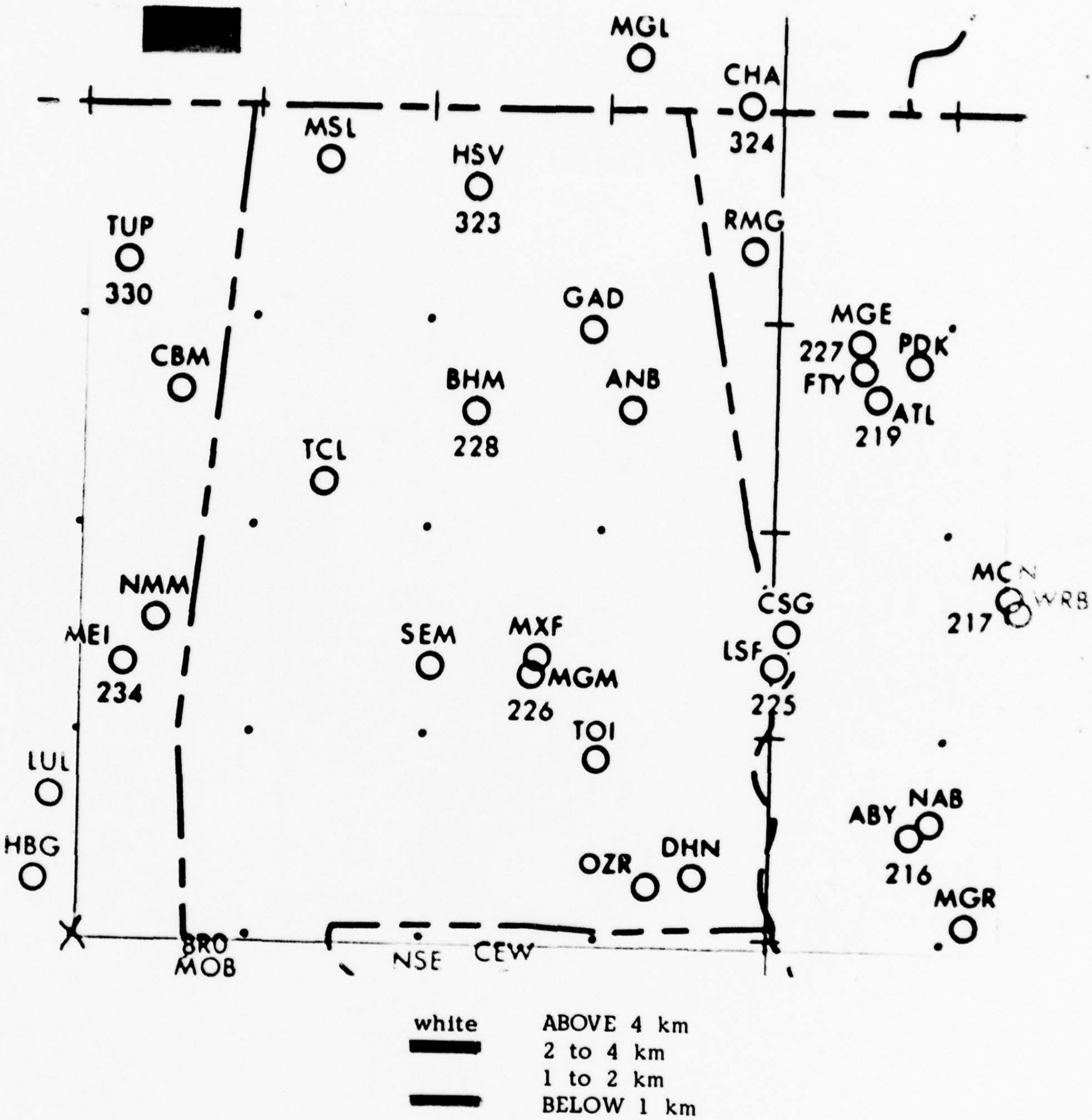


Fig. 5.16 Visibility 0040Z 27 Feb 1977 Computer Analysis

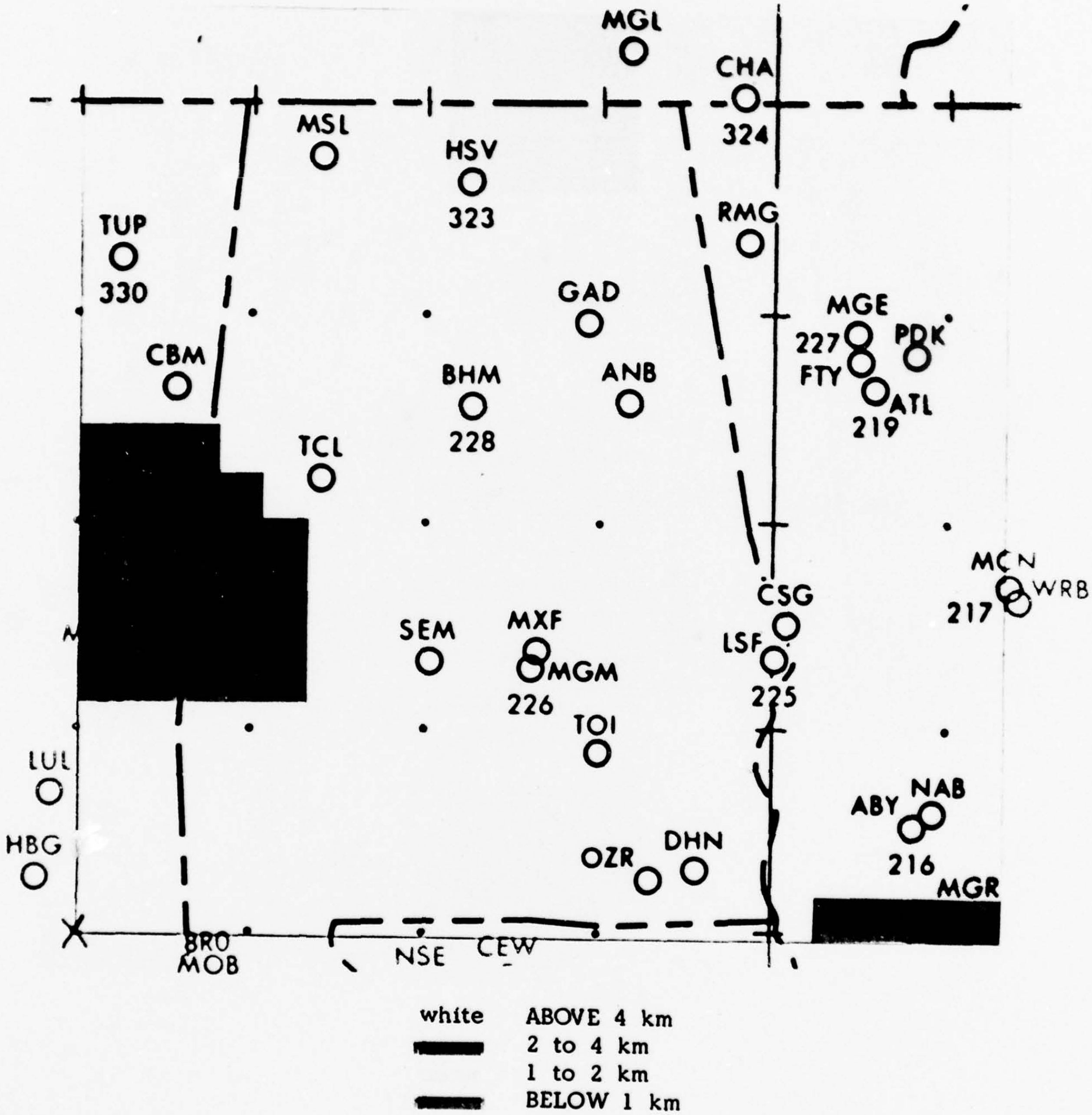


Fig. 5.17 Visibility 0340Z 27 Feb 1977 Computer Analysis

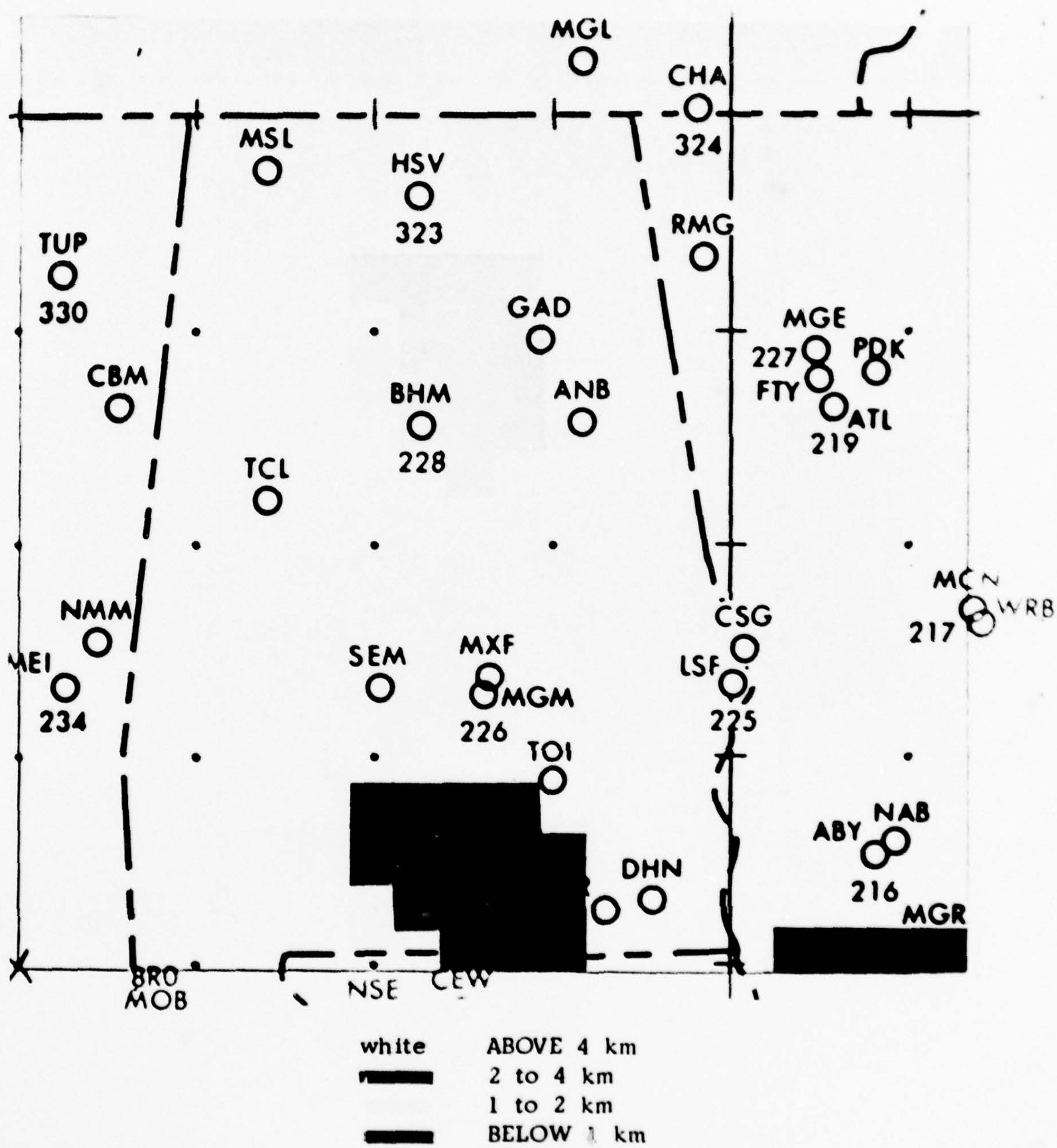
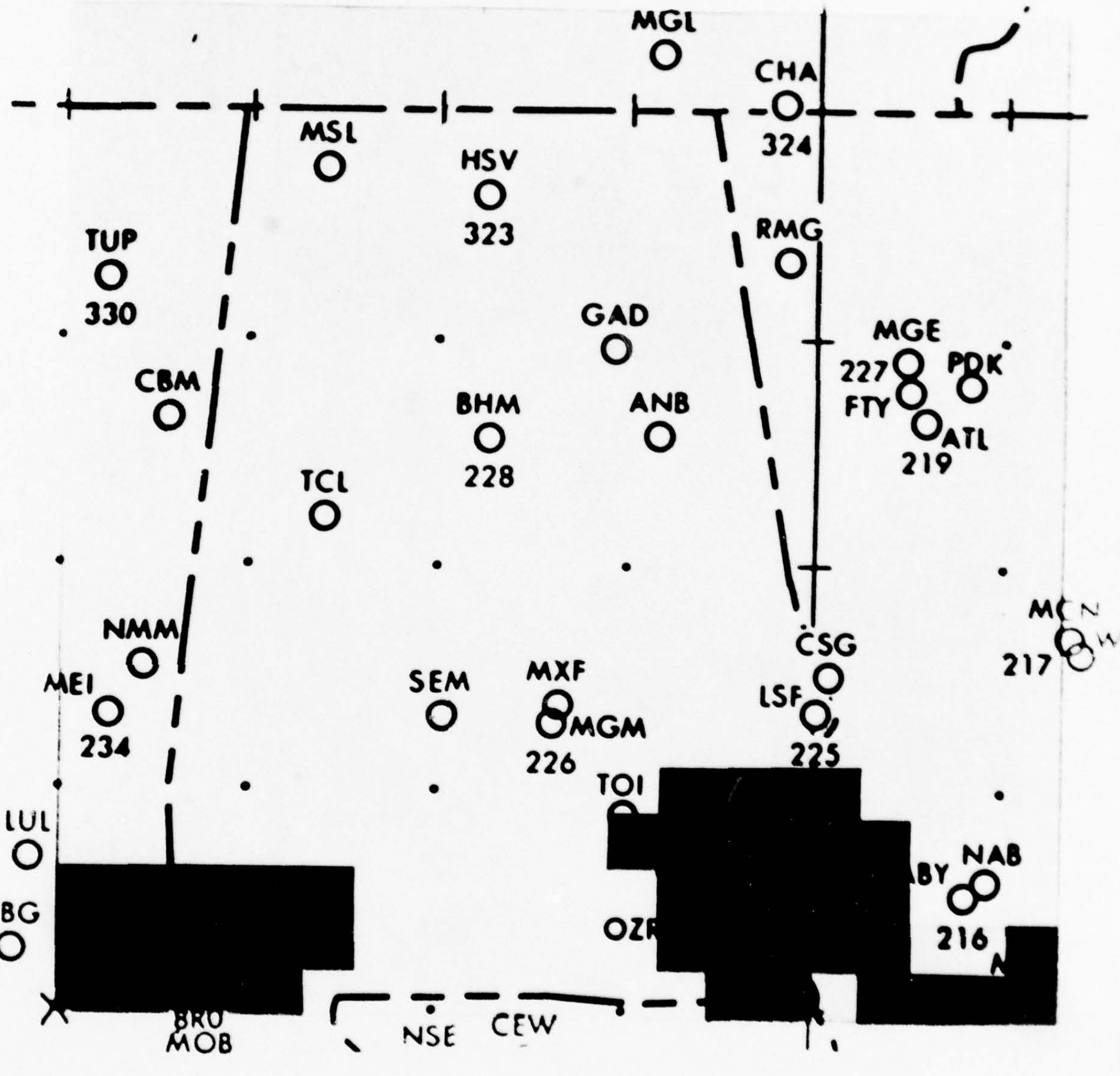


Fig. 5.18 Visibility 0510Z 27 Feb 1977 Computer Analysis



white ABOVE 4 km
2 to 4 km
1 to 2 km
BELOW 1 km

Fig. 5.19 Visibility 0640Z 27 Feb 1977 Computer Analysis

Fig. 5.20 Present Weather 0040Z 27 Feb 1977 Computer Analysis

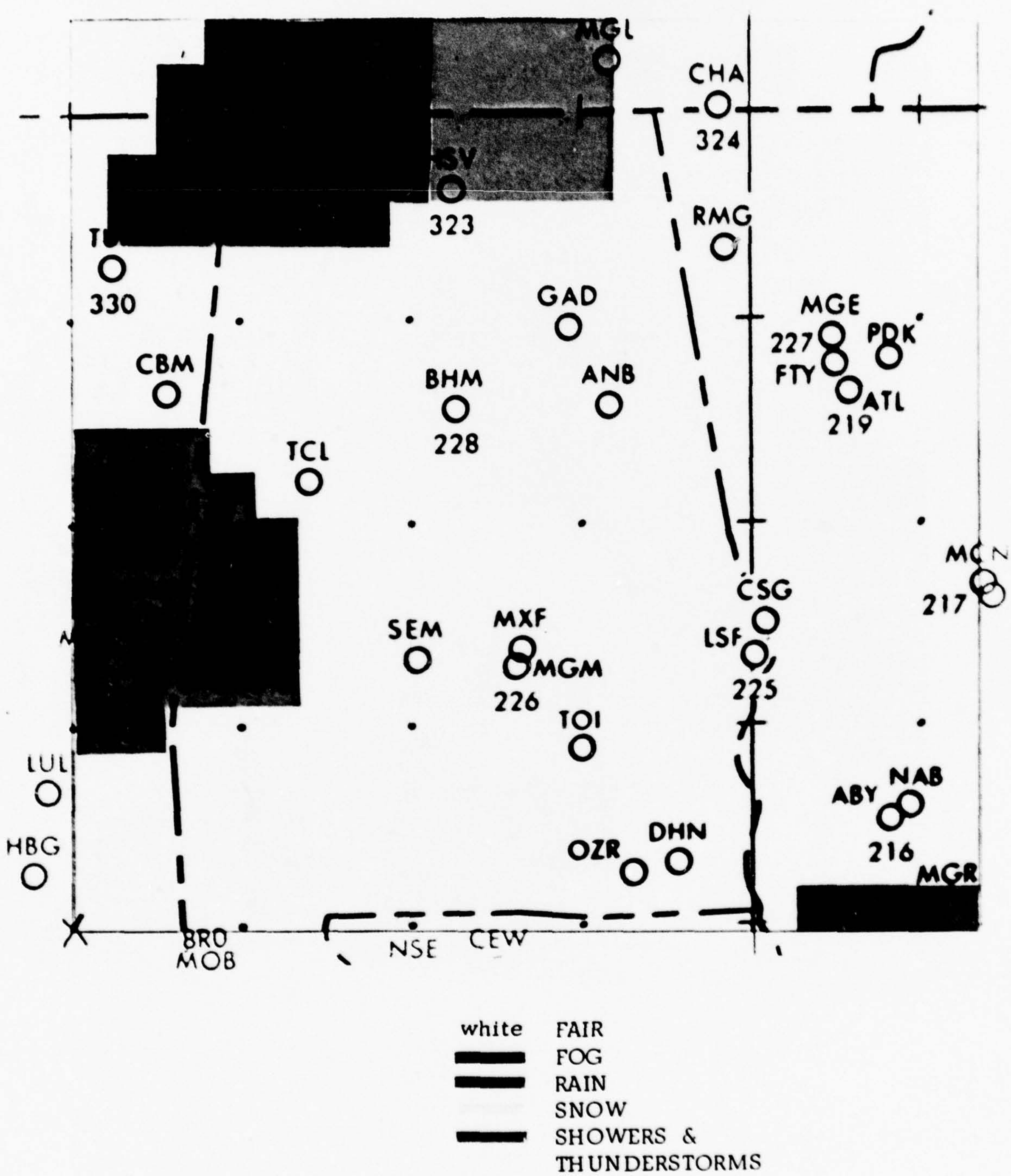


Fig. 5.21 Present Weather 0340Z 27 Feb 1977 Computer Analysis

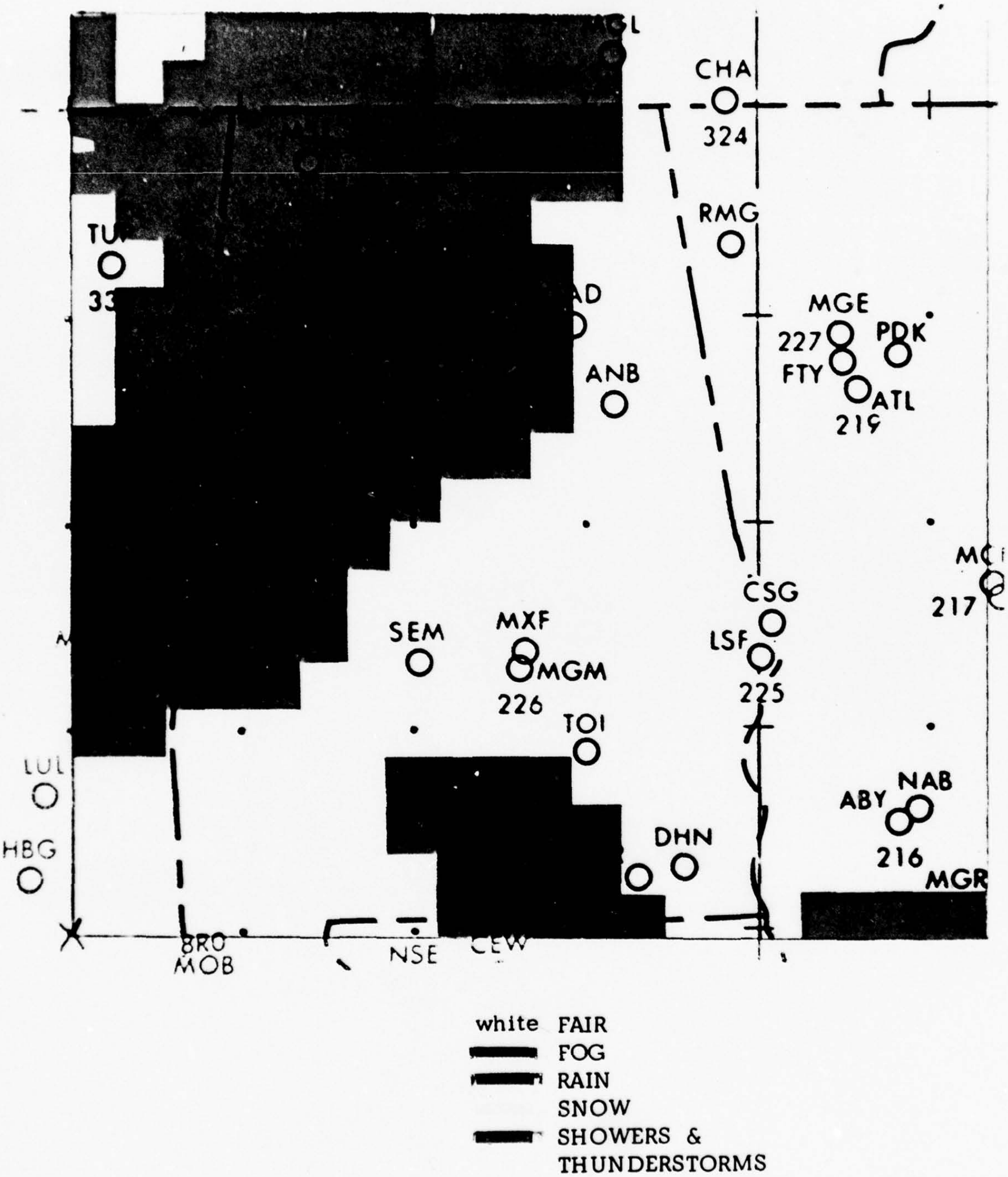


Fig. 5.22 Present Weather 0510Z 27 Feb 1977 Computer Analysis

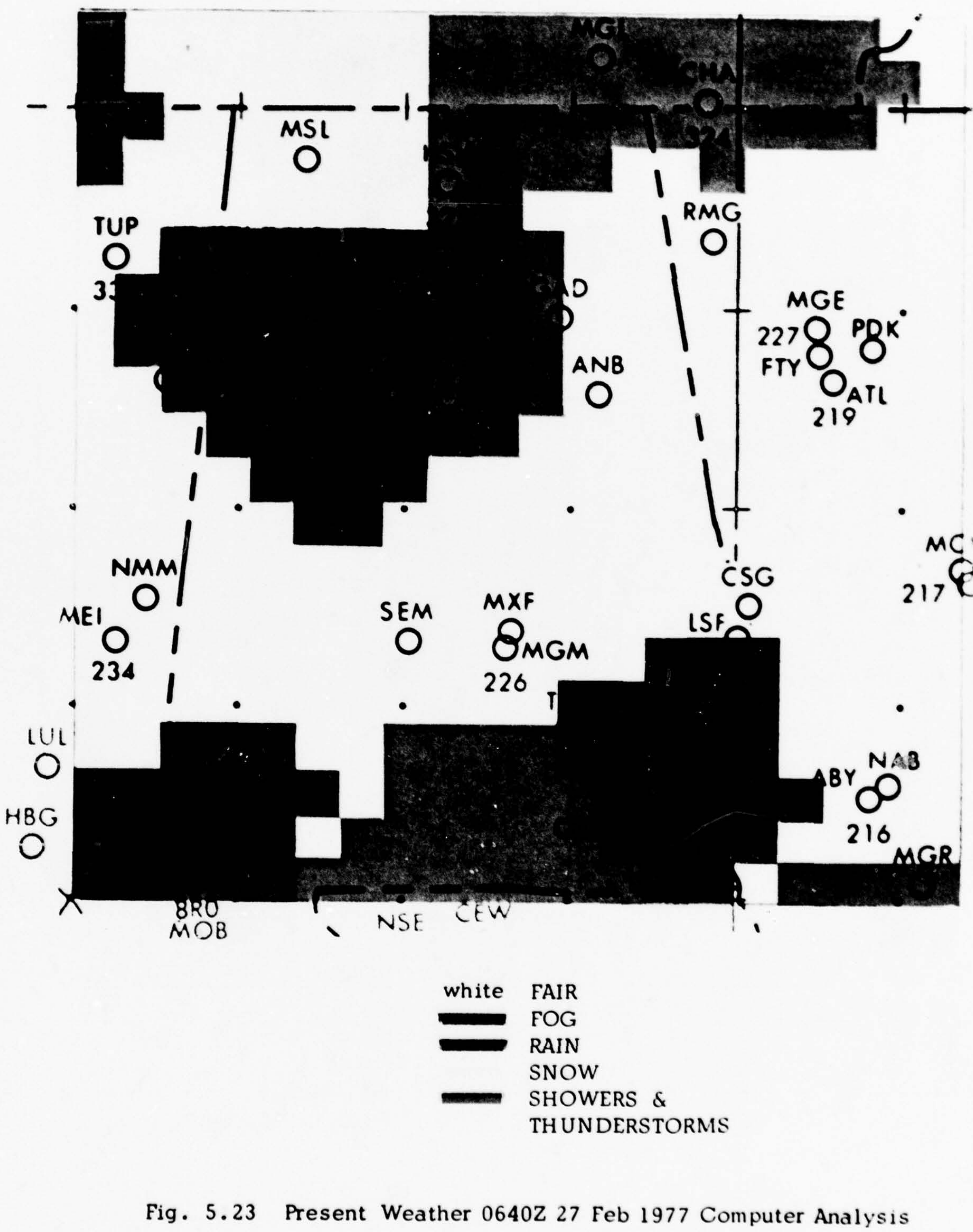


Fig. 5.23 Present Weather 0640Z 27 Feb 1977 Computer Analysis

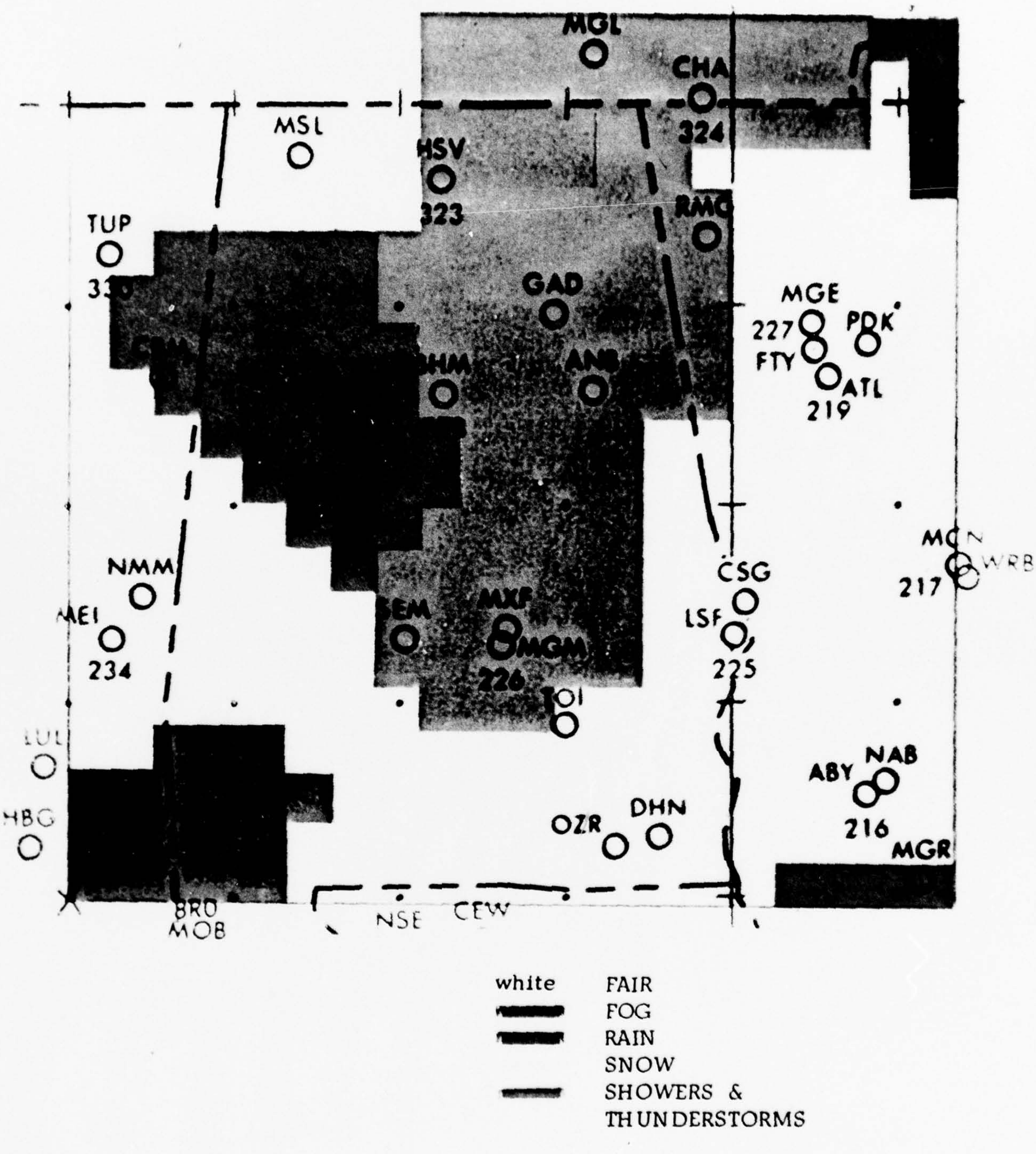


Fig. 5.24 Present Weather 0720Z 27 Feb 1977 Computer Analysis

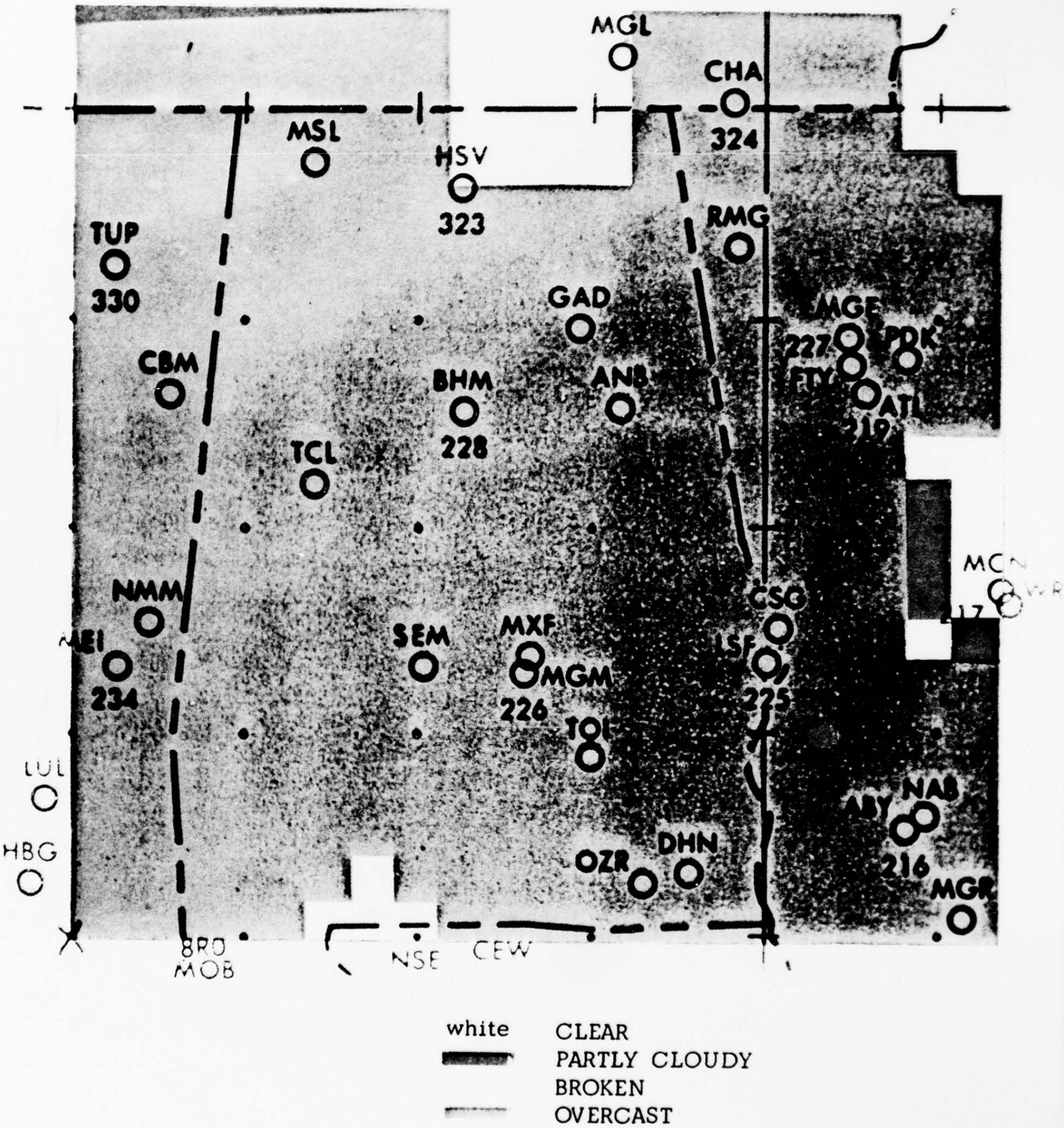
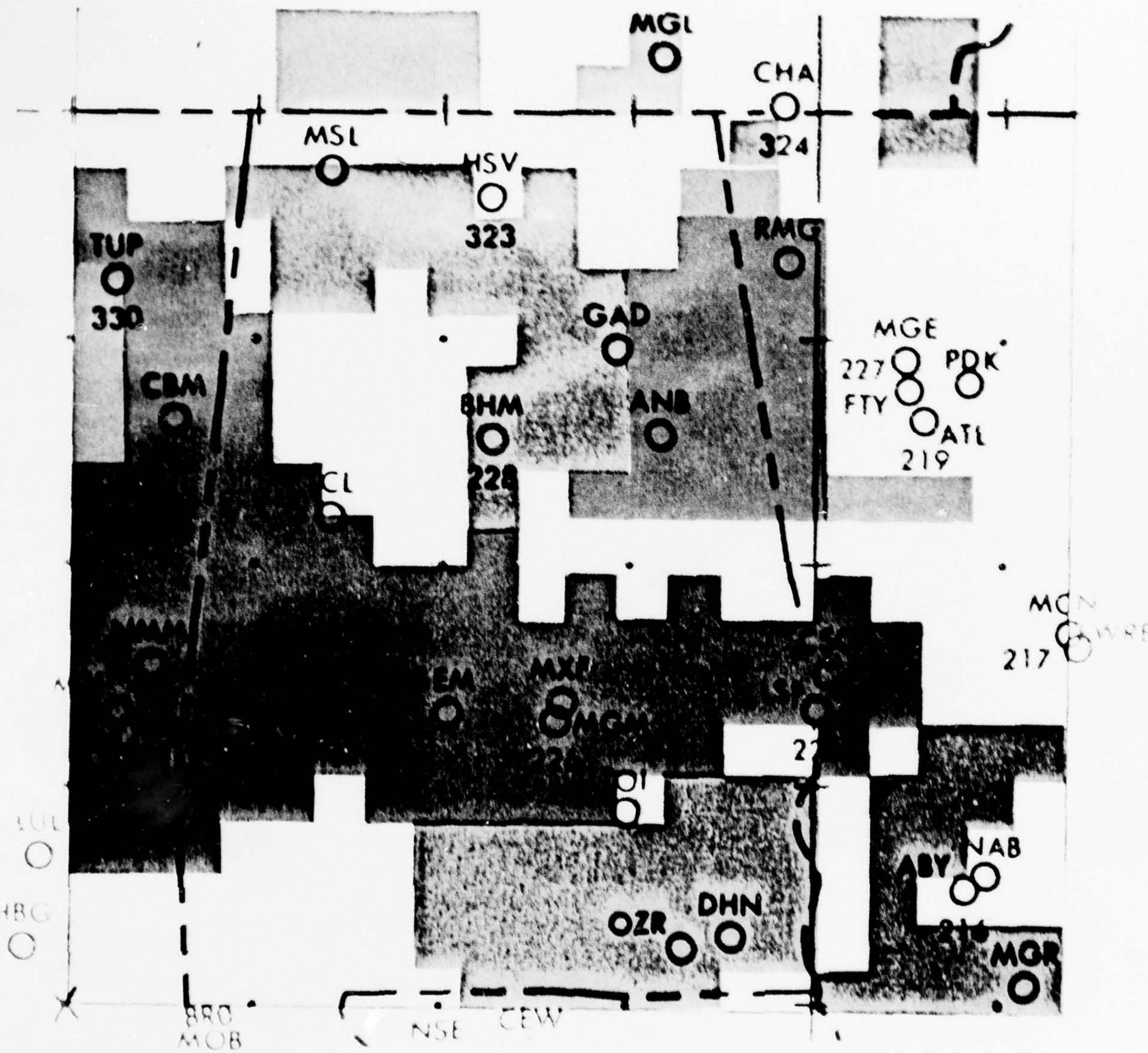


Fig. 5.25 Sky Cover 0640Z 27 Feb 1977 Computer Analysis



white	ABOVE 1.2 km
	.6 to 1.2 km
	.3 to .6 km
	.15 to .3 km
	BELOW .15 km

Fig. 5.26 Lowest Cloud Base 0640Z 27 Feb 1977 Computer Analysis

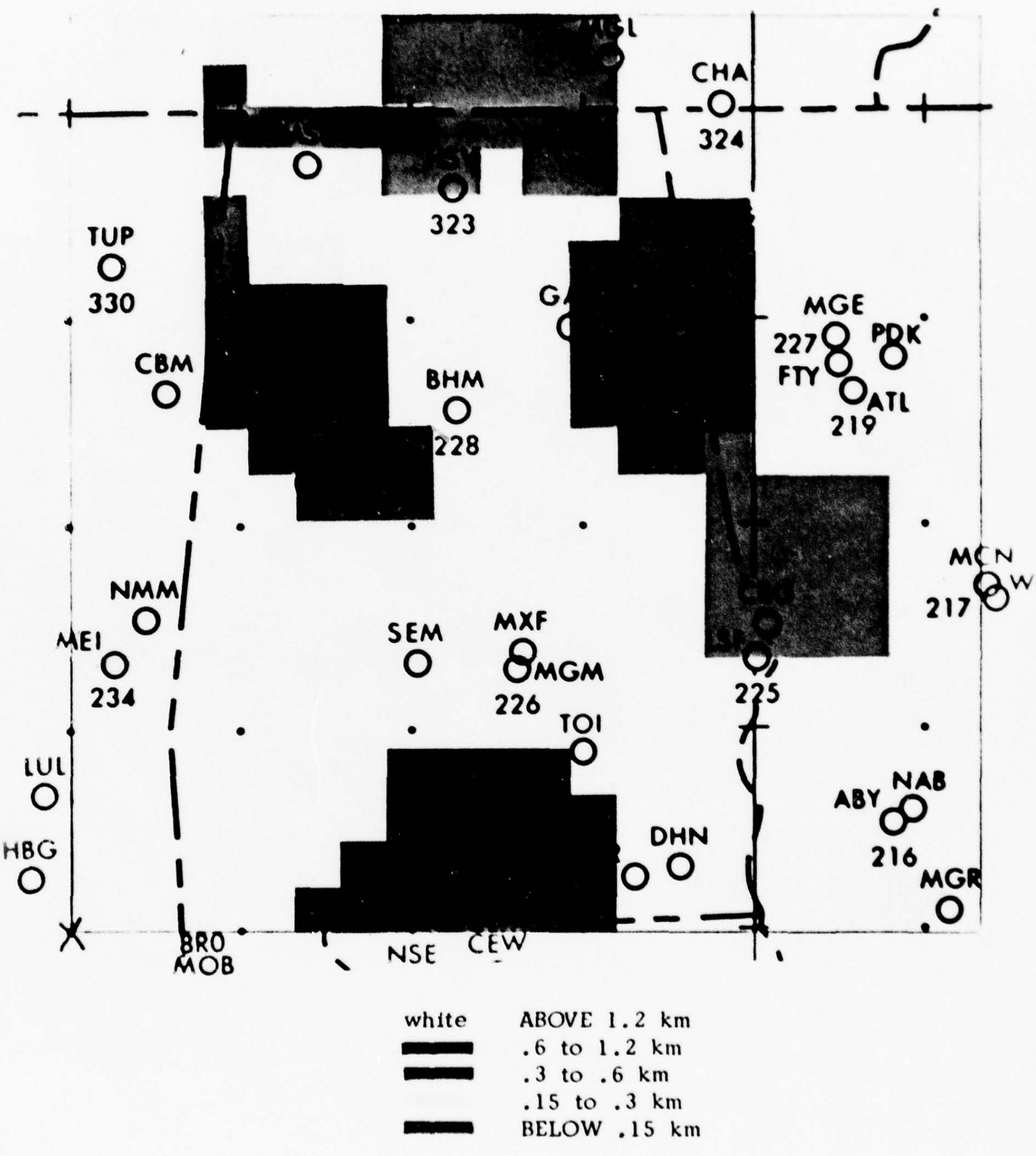


Fig. 5.27 Ceiling 0640Z 27 Feb 1977 Computer Analysis

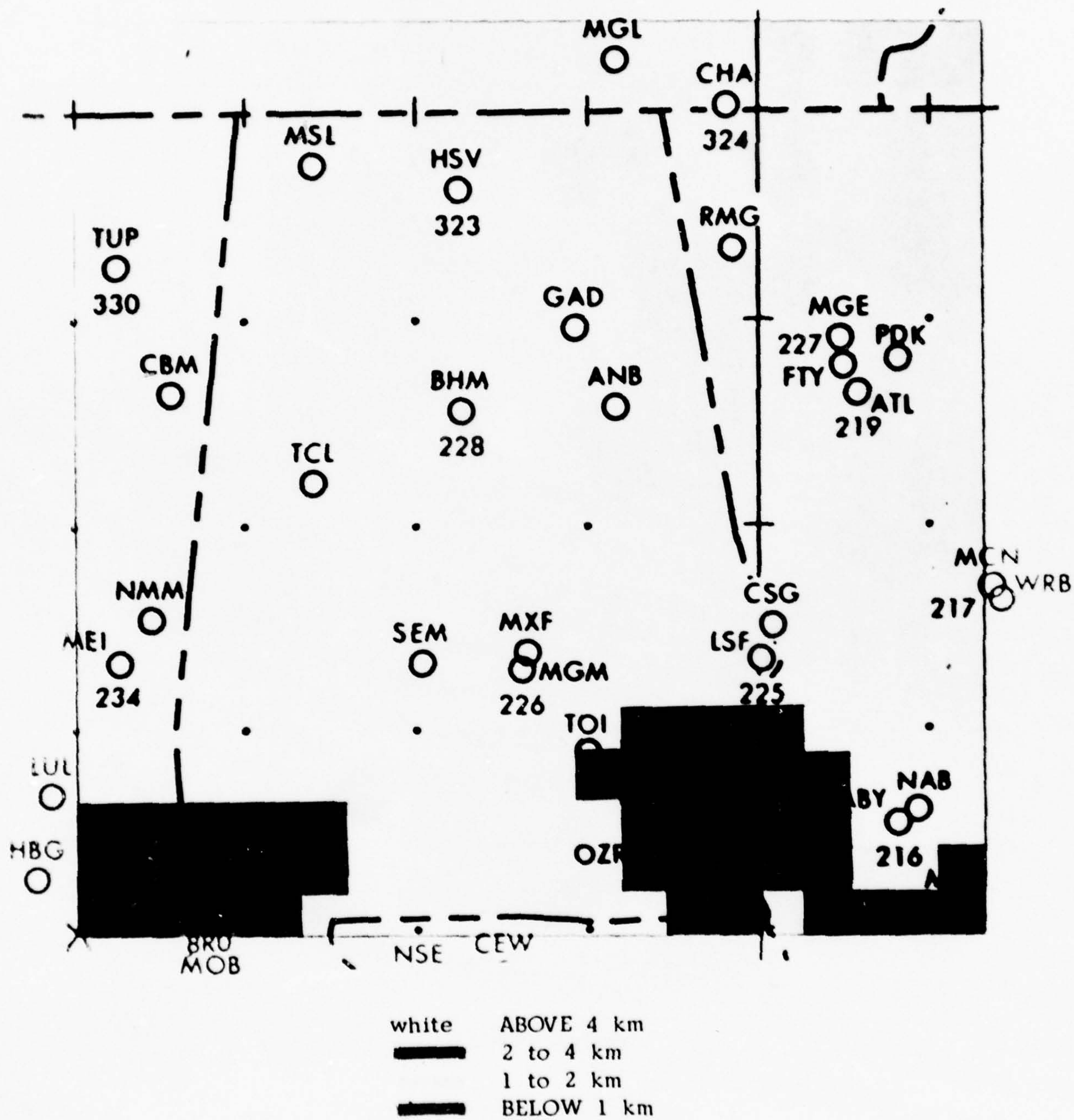
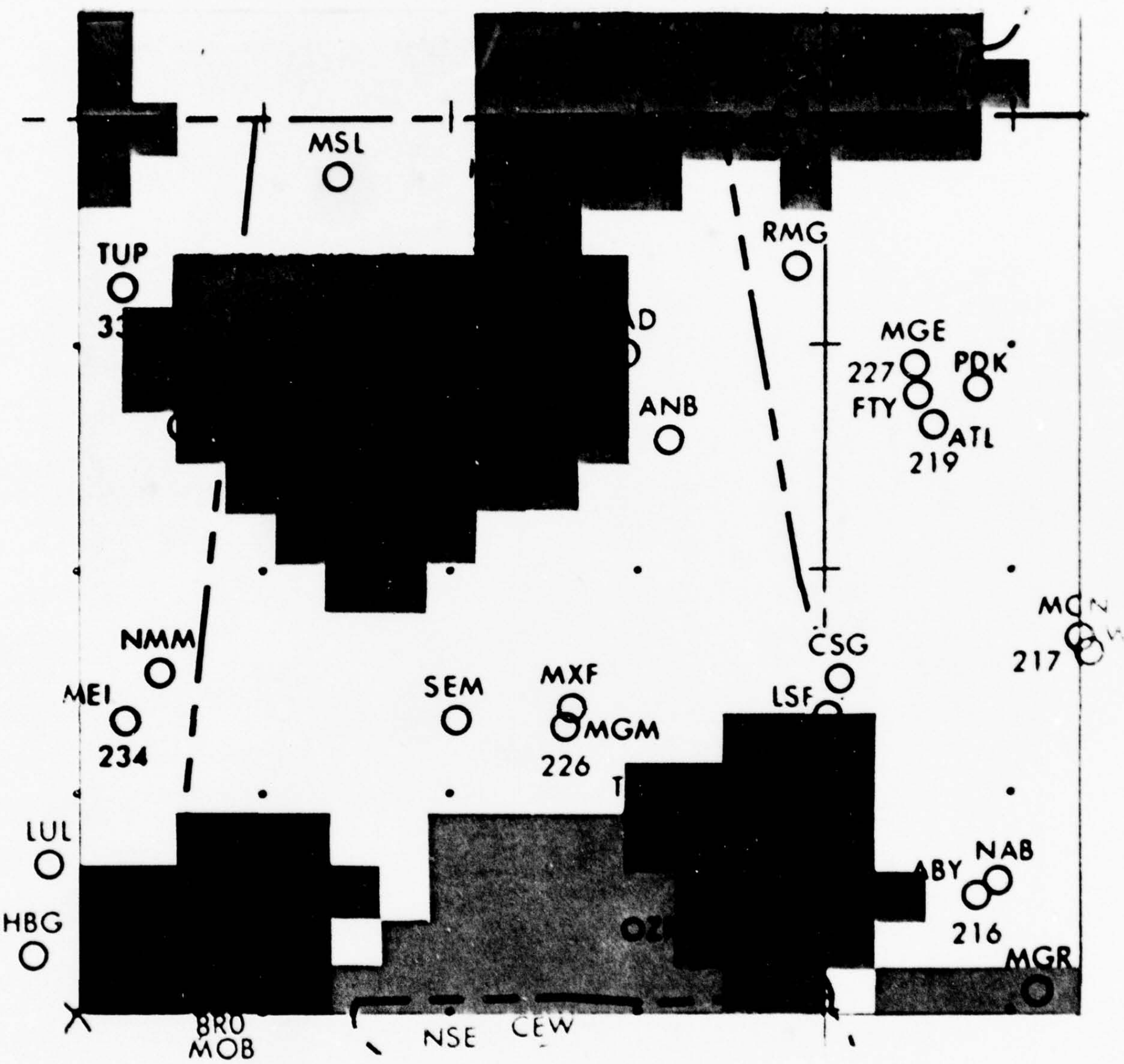


Fig. 5.28 Visibility 0640Z 27 Feb 1977 Computer Analysis



white FAIR
FOG
RAIN
SNOW
SHOWERS &
THUNDERSTORMS

Fig. 5.29 Present Weather 0640Z 27 Feb 1977 Computer Analysis

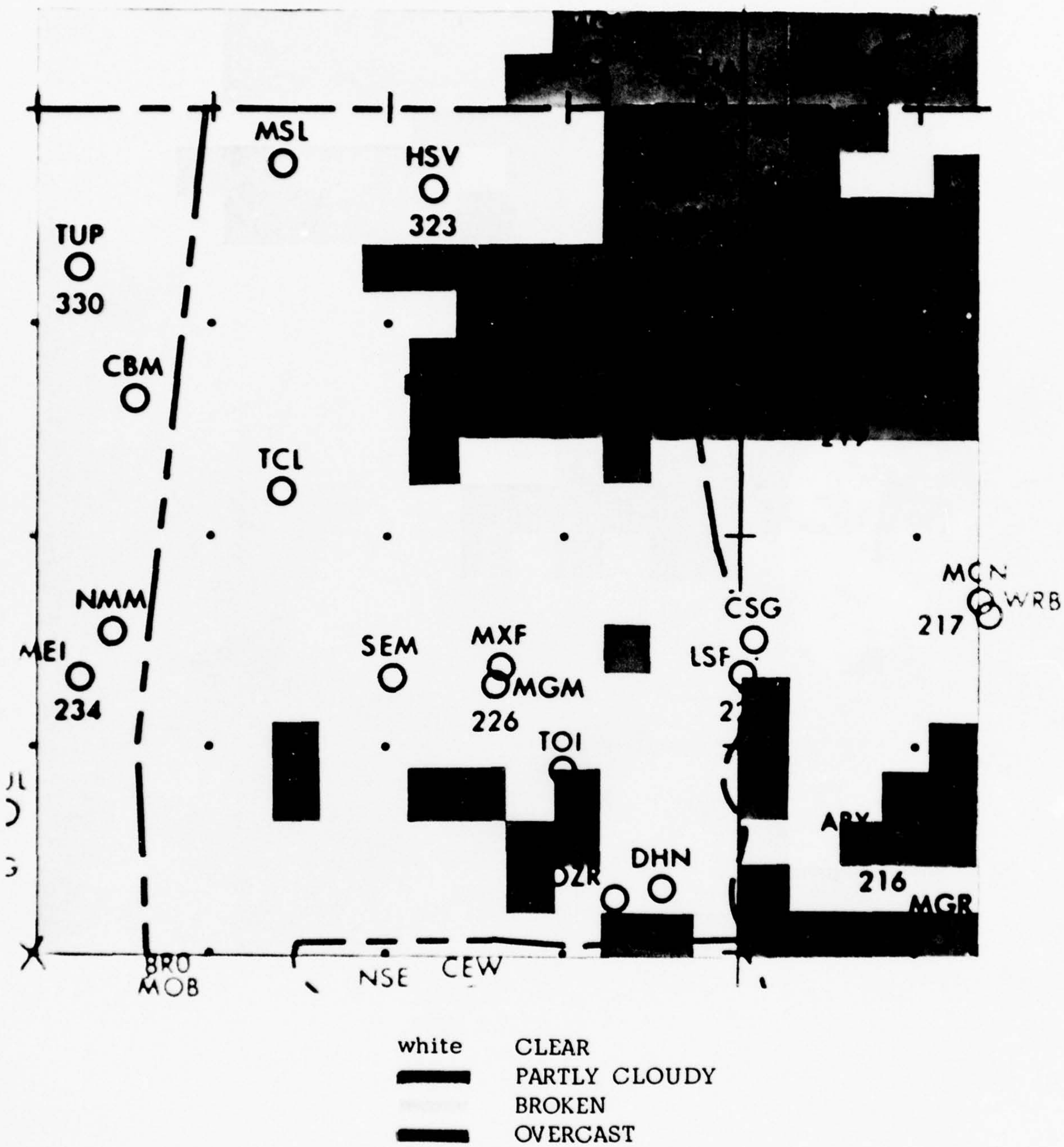
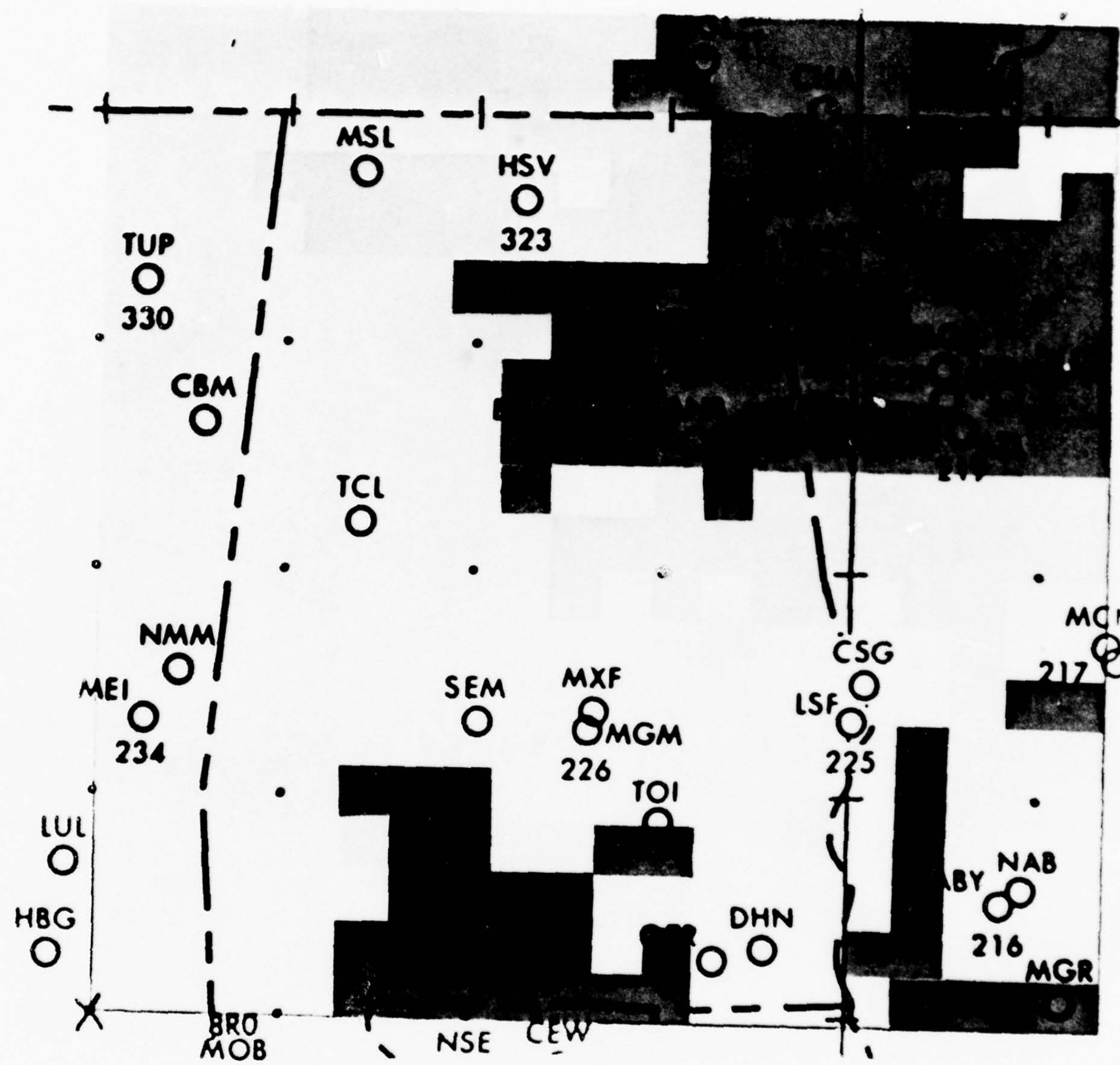
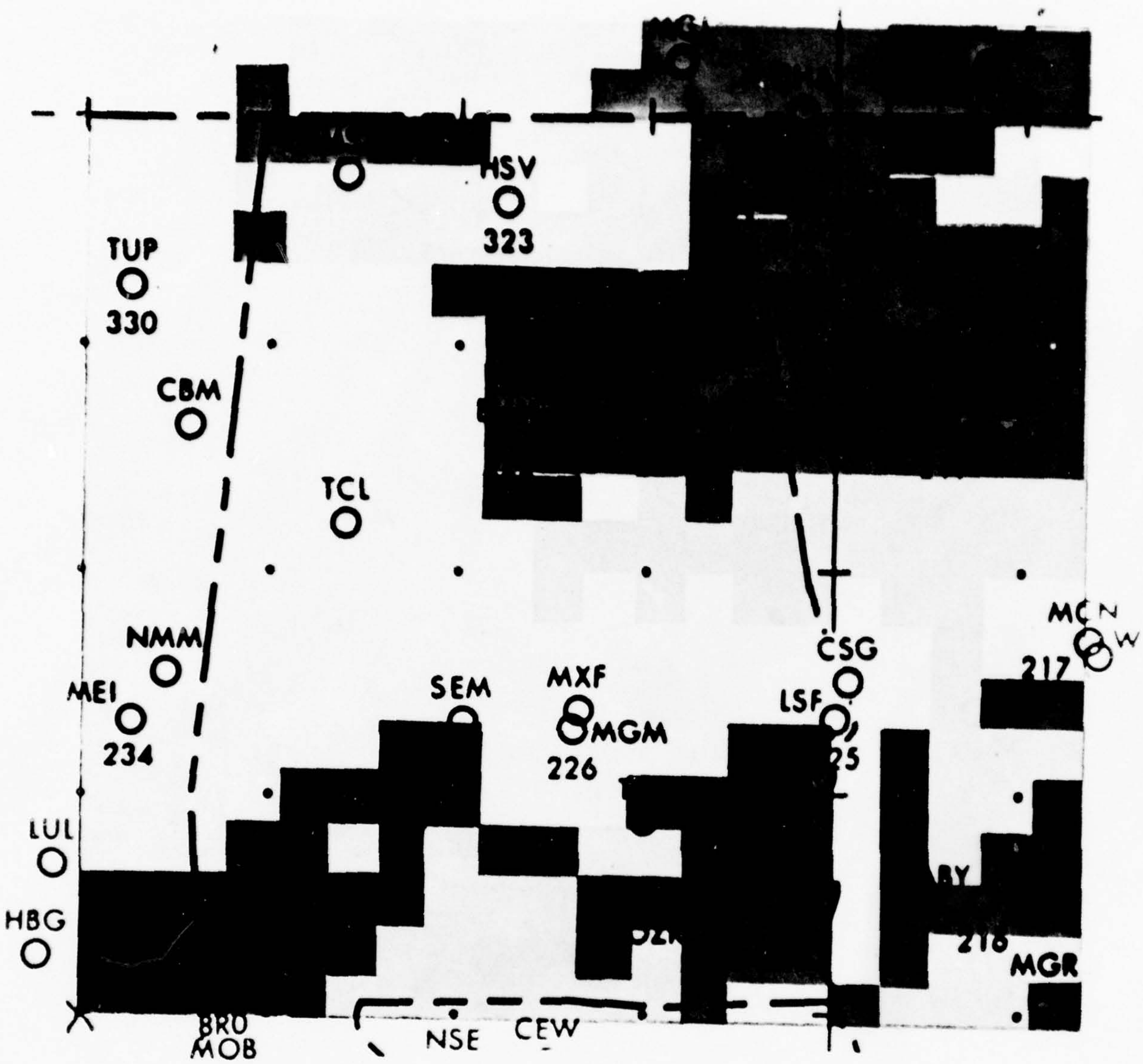


Fig. 5.30 Cloud Cover, Surface to 45 m AGL Layer, 0820Z 27 Feb 1977 Computer Analysis



white CLEAR
PARTLY CLOUDY
BROKEN
OVERCAST

Fig. 5.31 Cloud Cover, 45 to 91 m AGL Layer, 0820Z 27 Feb 1977 Computer Analysis



white	CLEAR
	PARTLY CLOUDY
	BROKEN
	OVERCAST

Fig. 5.32 Cloud Cover, 91 to 183 m AGL Layer, 0820Z 27 Feb 1977 Computer Analysis

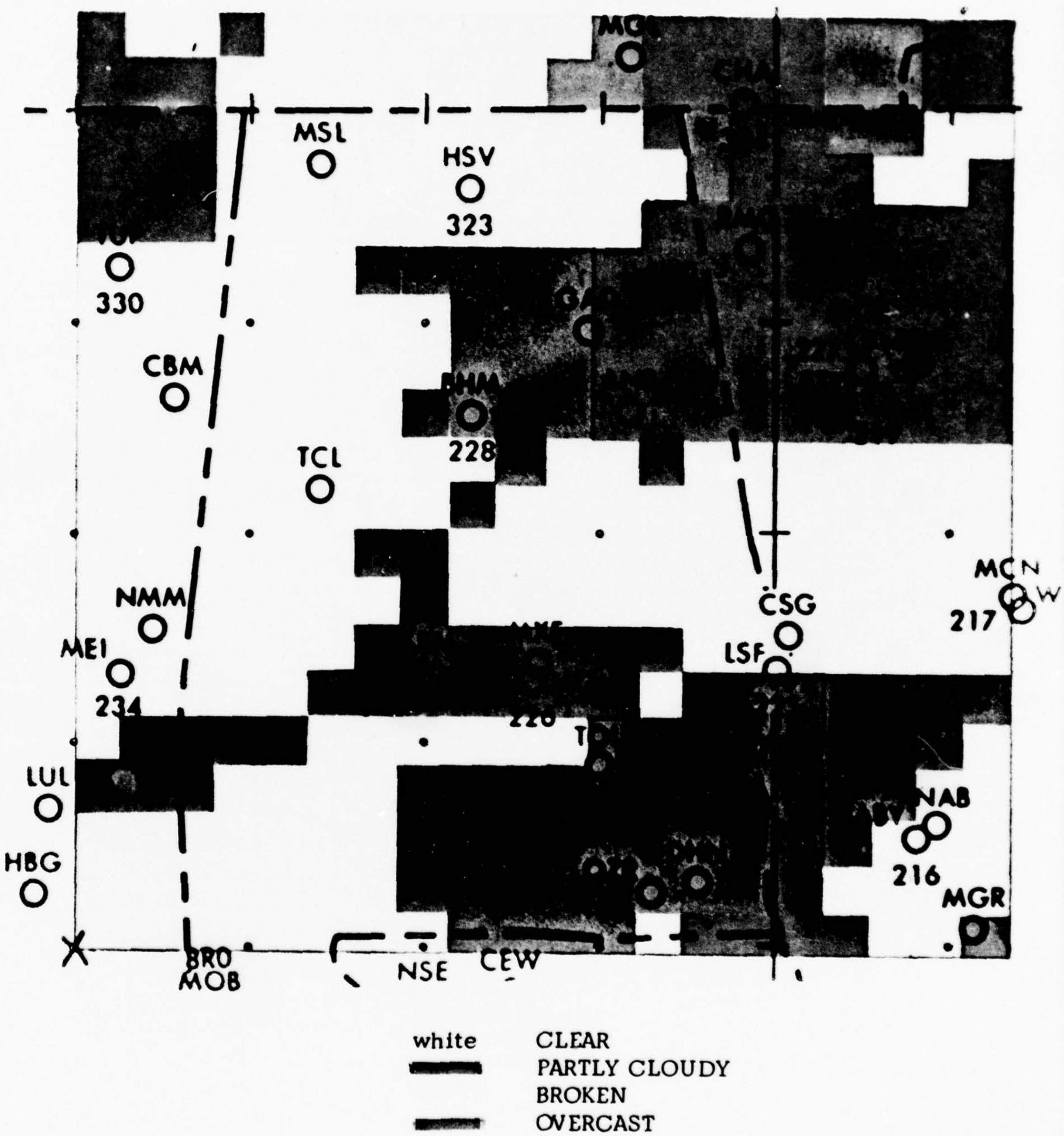


Fig. 5.33 Cloud Cover, 183 to 305 m AGL Layer, 0820Z 27 Feb 1977
Computer Analysis

6 RESULTANT MODIFICATIONS OF CFAS-CFAR PROGRAM ELEMENTS

6.1 SUMMARY

In the course of this effort, the CFAS-CFAR was used extensively on a large data base exhibiting a wide range of cloud formations, surface visibilities and weather phenomenon. As a result of this activity, the need for modifications to several CFAS-CFAR program elements was identified. These modifications were prompted by one or more of the following reasons:

1) Results of the sensitivity analysis
2) Discovery of errors or bugs
3) Improved operation of the system

The program elements affected and the modifications are described in the subsections which follow.

6.1.1 FORTRAN PROC .BASE (Univac 1106)

In order to minimize the data storage and instruction code size requirements of the CFAS-CFAR, the dimensions of several arrays contained in COMMON (BASE) must be tailored to the number of stations or reporting sites within the CFAS window and border and the frequency of the reports. In order to facilitate the changes that are required when

the window is relocated COMMON (BASE) and an associated DATA statement have been placed in FORTRAN PROC .BASE. This permits the incorporation of these declaratory statements contained in .BASE into the several subprograms which reference them through the use of a simple INCLUDE statement. The affected subprograms are:

.BEGIN	.GET1FW
.EXEC1	.ITOJ
.FIND1B	.NOSECT
.GETOB1	.STOREC
.GET1BW	.SECTOR

6.1.2 Main Program .CFMAIN/DSK (Univac 1106)

Main program .CFMAIN/DSK which runs the CFAS was revised to incorporate the findings of sensitivity analysis. The analysis control parameters whose values have now been fixed as a result of this study are now contained within DATA statements and are no longer input via READ statements. The revised input data stream now required for TASK 3 is given in Table 6.1. In addition to these changes, there has also been incorporated into .CFMAIN/DSK a provision to allow the interpreted observations to be printed out following a TASK 2. This feature is actuated by inserting a SETC command in the runstream at some point prior to the XQT command. The printout of the interpreted observations

TABLE 6.1 Input Data Stream for CFAS TASK 3

Line	Data Elements	Format
1	TASK, NPRT, NOWTYM	3I10
2	NBKOUT	I10
3	TIME, TYMOLD	2I10
5	IDENT	10A6

Data Element	Definition
TASK	TASK=3 for an analysis at all grid points in the window
NPRT	NPRT 0 the grid point analysis is printed out NPRT=0 no printout of the grid point analysis
NOWTYM	The current clock time
NBKOUT	The number of the most recent record on the CFDB file
TIME	Time of the most recent observation to be used in the analysis
TYMOLD	Time of the oldest observation to be used in the analysis
IDENT	A user defined sixty character label which identifies the CFDB record

is independent of the optional echo printout of the observations on read-in which has always existed in the CFAS.

6.1.3 Subprogram .CFMAP (Univac 1106)

A minor bug was discovered in CFMAP relating to situations in which the nearest observation to a grid point was nevertheless distant enough so as to produce a very small weighting function. The modification incorporated into CFMAP established a minimum value for the smallest weighting function. If the smallest weighting function is less than the minimum value, a missing value is inserted at the grid point for the parameter being analyzed.

6.1.4 Subprogram .COMOBR (Univac 1106)

The criteria for ranking observations in the building of a best report were modified and reordered. The criteria for ranking observations used in creating a best report are now applied in the following order:

1 - Time of observation

2 - Type of observation

1 - Airways
2 - Metar
3 - Synop
4 - Raob
5 - AFGWC-3DNEPH

3 - Value of observation

4 - Urgency of observation

5 - Distance from best report site

6.1.5 Subprogram .EXEC1 (Univac 1106)

Modifications of subprogram .EXEC1 were made in connection with the use of PROC .BASE (Section 6.1.1) and the optional printout of interpreted observation (Section 6.1.2).

6.1.6 Subprogram .EXEC2 (Univac 1106)

Subprogram .EXEC2 was modified to permit the incorporation of the grid point altitudes via an INCLUDE statement. The grid point altitudes are carried in FORTRAN PROC .GRDPOINTALT.

6.1.7 FORTRAN PROC .GRDPOINTALT (Univac 1106)

The PROC .GRDPOINTALT contains the DIMENSION and DATA statements in which the array of grid point altitudes are stored. As is the case with PROC .BASE, PROC .GRDPOINTALT is dependent upon the location of the CFAS window. The use of PROC elements and the INCLUDE statements which are available on high level FORTRAN's, such as FORTRAN V, provide a convenient and relatively error safe means of entering semi-permanent parameters and constants into the CFAS elements.

6.1.8 Subprogram .SFDINT (Univac 1106)

A modification was made to subprogram .SFDINT to incorporate a test and rectification, if necessary, to insure that the maximum heights of cloud tops which are derived from weather information are equal to or greater than the observed minimum bases of clouds.

6.1.9 Subprogram .SHADE

An error was uncovered in subprogram .SHADE which resulted in the incorrect shading on most significant present weather maps of weather categories 40 - 49. The error was corrected.

7 CONCLUSIONS AND RECOMMENDATIONS

1. Reduced station density adversely affects the accuracy of the analysis at individual grid points since more distant observations must be used in analyzing the CFAS parameters at the grid point.
2. The worst objective analysis results were as expected, associated with regions having no data (silent area) and with small space and time scale phenomena, such a rapidly moving scud type clouds near the earth's surface.
3. The inclusion of older observations at stations at which there exists current observations is of value only to the extent that missing elements in the current observations can be supplemented by non-missing values in the older observations.
4. Reduced station density causes an increase in running time. This is due to the fact that the CFAS is designed to systematically search square areas of increasing size around the grid point until a minimum number of observations is found. The time required for the search is inversely proportional to the density of the observations. The time impact of observation density will have to be carefully considered when a computer is selected for operationally

implementing CFAS. It is also possible to modify and optimize the CFAS for specific observational densities and distributions. This should also be considered before implementation of the system.

5. It is possible to trade off analysis accuracy against computer time required for an analysis by varying the allowable search square control parameter.
6. Consideration should be given to handling a problem likely to exist within a battlefield environment where close and conflicting observations dictate the need for a technique that provides discrimination among reports, maintains spatial resolution, yet emphasizes operationally critical features.
7. The distance and time factors used to weight the influence of distant observations to a grid point value proved totally adequate to handle all meteorological variables tested, with the possible exception of visibility which should be explored more thoroughly in view of its importance to many Army operations.
8. No instabilities were detected in the CFAS analysis procedures.
9. A most significant result of this study was the establishment of the fact that the CFAS/CFAR objective analysis and display techniques remained stable and continued to perform under excessive variations of control parameters and type, distribution, and density of

observations. This made it possible to fix control parameters and eliminate these as user inputs. The computer programs have been modified to incorporate these advances and a Univac 1100 series compatible tape containing the new program has been delivered to Atmospheric Sciences Laboratory.

10. Presentations of the CFAS and CFAR analyses should be made to Army personnel to demonstrate some possible types of output, to solicit critical comments and support, and to generate a list of additional products that would increase the value to Army users.

8 APPENDICES

8.1 UTILITY PROGRAM LISTINGS

```
      PROGRAM COLUMN
      DIMENSION PAGE(55,5,20)
      DOUBLE PRECISION INFILE,OUTFIL
      LOGICAL EOF
      EOF=.FALSE.

      TYPE 1
    1 FORMAT (' INPUT INFILE.EXT,INUNIT,IOUT.EXT,OUTUNT')
      ACCEPT *, INFILE,INUNIT,OUTFIL,IOUT
      OPEN (UNIT=INUNIT,FILE=INFILE,ACCESS='SEQIN')
      OPEN (UNIT=IOUT,FILE=OUTFIL,ACCESS='SEQOUT')

    5 DO 2 I=1,5
      DO 2 J=1,55
      DO 2 K=1,20
    2 PAGE(J,I,K)=' '

      DO 10 I=1,5
         DO 20 J=1,55
            READ (INUNIT,30,END=31) (PAGE(J,I,K),K=1,20)
   20    CONTINUE
   10 CONTINUE
   30 FORMAT (20A1)
   35 DO 40 J=1,55
         WRITE (IOUT,60) ((PAGE(J,I,K),K=1,20),I=1,5)
   40 CONTINUE
      WRITE (IOUT,11)
   11 FORMAT (16X,100('*'))
   60 FORMAT (1X,3(20A1,8X),20A1,7X,20A1)
      IF (.NOT. EOF) GOTO 5
      GOTO 99
   31 EOF=.TRUE.
      GOTO 35
   99 CONTINUE
      END
```

```
      PROGRAM CONVER
      INTEGER ALT,EST,NTH,LAB,DEG,DEG1,MIN,MIN1,NEXLAB
      REAL REFLON,REFLAT,CMRD,REFEST,REFNTH,LON,LAT,EAST,NORTH
      OPEN (UNIT=20,FILE='JACK.DAT')
      OPEN (UNIT=22,FILE='RAFP.DAT')
      TYPE 1
    1 FORMAT (' REFERENCE LONG')
      ACCEPT*,REFLON
      TYPE 2
    2 FORMAT (' REFLAT')
      ACCEPT*,REFLAT
      TYPE 3
    3 FORMAT (' CMRD')
      ACCEPT*,CMRD
      WRITE (5,4) REFLON,REFLAT,CMRD
    4 FORMAT (3F10.3)
      LABEL=0
      CALL UTM (REFLON,REFLAT,REFEST,REFNTH,CMRD)
      READ (20,20) STATIN,DEG,MIN,DEG1,MIN1,ALT
      LON=FLOAT(DEG)+(FLOAT(MIN)/60.)
      LAT=FLOAT(DEG1)+(FLOAT(MIN1)/60.)
      CALL UTM (LON,LAT,EAST,NORTH,CMRD)
      EST=INT(1000.*(EAST-REFEST))
      NTH=INT(1000.*(NORTH-REFNTH))
      WRITE (22,30) STATIN,EST,NTH,ALT
   10 READ (20,20,END=50) STATIN,DEG,MIN,DEG1,MIN1,ALT
      LABEL=LABEL+10
      LON=FLOAT(DEG)+(FLOAT(MIN)/60.)
      LAT=FLOAT(DEG1)+(FLOAT(MIN1)/60.)
      CALL UTM (LON,LAT,EAST,NORTH,CMRD)
      EST=INT(1000.*(EAST-REFEST))
      NTH=INT(1000.*(NORTH-REFNTH))
      NEXLAB=LABEL+10
      WRITE (22,40) LABEL,STATIN,NEXLAB,EST,NTH,ALT
      GOTO 10
   20 FORMAT (A,5I)
   30 FORMAT (6X,17HIF (STATIN .NE. ',A3,10H') GOTO 10,/,10X,'JX=',I5,
     +          /,10X,'JY=',I5,/,10X,'JZ=',I5,/,10X,'GOTO 500')
   40 FORMAT (2X,I3,1X,17HIF (STATIN .NE. ',A3,7H' GOTO ,I3,/,10X,'JX=',
     +          I5,/,10X,'JY=',I5,/,10X,'JZ=',I5,/,10X,'GOTO 500')
   50 CONTINUE
      END
      SUBROUTINE UTM(LON,LAT,EAST,NORTH,CMRD)
      REAL LAT,LON,NORTH
      A=63.782064
      ARED=63.350345
      E=.0068147849
      Q=.017453292*LAT
      P=3600.*(CMRD-LON)
      C=COS(Q)
      S=SIN(Q)
```

```
      T=S/C
      S2=2.*S*C
      D=1.-(2.*S*S)
      S4=2.*S2*D
      RHO=A/SQRT(1.-(6.7686580E-03*S*S))
      D=Q+(.005076492*(Q-(.5*S2)))+
     +     (4.29513E-05*((1.5*Q)-S2+(S4/8.)))
      XN1=ARED*D
      D=C*S*1.1752215E-11*P*P
      D=D+((C**3)*S*2.3015189E-23*(P**4)*
     +     (5.-(T*T)+(9.*((E*C)**2))+(4.*((E*C)**4))))
      NORTH=.9996*(XN1+(D*RHO))
      D=C*4.8481368E-06*P
      D=D+((C**3)*(1.-(T*T)+((E+C)**2))*1.8992115E-17*(P**3))
      EAST=(RHO*D*.9996)+5
      RETURN
      END
```

```
      PROGRAM SYNOP
      INTEGER INUNIT,OUTUNT,TESTER,DATE,TIME,LAYERS,WETHRS,VISIBL,
     +        MISSNG,N,NH,CL,H,CM,CH,W,WW,PPP,TT,TDTD,JX,JY,JZ,TYPEC
      DOUBLE PRECISION INFILE,OUTFIL
      DIMENSION TEST(7)

      TYPE 10
   10 FORMAT (' NAME THE INPUT UNIT AND INPUT FILE.EXT')
      ACCEPT *, INUNIT,INFILE

      TYPE 20
   20 FORMAT (' NAME THE OUTPUT UNIT AND OUTPUT FILE.EXT')
      ACCEPT *, OUTUNT,OUTFIL

      OPEN (UNIT= INUNIT, FILE= INFILE, ACCESS='SEQIN')
      OPEN (UNIT= OUTUNT, FILE= OUTFIL, ACCESS='SEQOUT')

      MISSNG= -32768
      TYPEC= 3

   30 READ (INUNIT,100, END= 90, ERR= 40) TESTER
      REREAD 110, DATE,TIME
      READ (INUNIT,120) (TEST(I),I=1,5)

   40 REREAD 130, STATIN, TYPE, LAYERS, WETHRS, VISIBL
      REREAD 120, (TEST(I),I=1,5)
      IF (TEST(5) .EQ. ' ') VISIBL=MISSNG
      IF (TYPE .NE. 'C' .OR. LAYERS .NE. 0 .OR. WETHRS .NE. 1) GOTO 70

      READ (INUNIT,110) N,NH,CL,H,CM,CH,W
      REREAD 120, (TEST(I),I=1,7)
      IF (TEST(1) .EQ. ' ')  N=MISSNG
      IF (TEST(2) .EQ. ' ') NH=MISSNG
      IF (TEST(3) .EQ. ' ') CL=MISSNG
      IF (TEST(4) .EQ. ' ')  H=MISSNG
      IF (TEST(5) .EQ. ' ') CM=MISSNG
      IF (TEST(6) .EQ. ' ') CH=MISSNG
      IF (TEST(7).EQ. ' ')  W=MISSNG

      READ (INUNIT,100,ERR=50) TESTER
      REREAD 110, WW
      GOTO 60
   50 WW=MISSNG

   60 READ (INUNIT,110) PPP, TT, TDTD
      REREAD 120, (TEST(I),I=1,3)
      IF (TEST(1) .EQ. ' ')  PPP= MISSNG
      IF (TEST(2) .EQ. ' ')   TT= MISSNG
      IF (TEST(3) .EQ. ' ') TDTD= MISSNG
```

```
      CALL CONVRT (STATIN,JX,JY,JZ,TIME,ITIME)
      WRITE (OUTUNT,140) JX,JY,JZ,ITIME,TYPEC,VISIBL,LAYERS
      WRITE (OUTUNT,140) N,NH,CL,H,CM,CH,W
      WRITE (OUTUNT,140) WW,MISSNG,MISSNG,MISSNG,MISSNG,MISSNG,MISSNG
      GOTO 30

   70 TYPE 80,DATE,TIME,STATIN,TYPE,LAYERS,WETHRS,VISIBL
   80 FORMAT (' ERROR AT ',2I7,2A5,3I4)
   90 CONTINUE

  100 FORMAT (I1)
  110 FORMAT (8I)
  120 FORMAT (8A)
  130 FORMAT (2A,3I)
  140 FORMAT (8I10)
      END
      SUBROUTINE CONVRT (STATIN,JX,JY,JZ,TIME,ITIME)
      INTEGER JX,JY,JZ,TIME,HOURS,MIN

      HOURS=TIME/100
      MIN=TIME-(HOURS*100)
      ITIME=(HOURS*60)+MIN

      IF (STATIN .NE. 'ABY') GOTO 10
          JX= 5821
          JY= 2058
          JZ=   60
          GOTO 500
   10 IF (STATIN .NE. 'AGS') GOTO  20
          JX= 7834
          JY= 4169
          JZ=   45
          GOTO 500
   20 IF (STATIN .NE. 'AHN') GOTO  30
          JX= 6552
          JY= 4764
          JZ=  247
          GOTO 500
   30 IF (STATIN .NE. 'AQQ') GOTO  40
          JX= 5097
          JY=   46
          JZ=   11
          GOTO 500
   40 IF (STATIN .NE. 'ATL') GOTO  50
          JX= 5527
          JY= 4400
          JZ=  315
          GOTO 500
   50 IF (STATIN .NE. 'AYS') GOTO  60
          JX= 7531
          JY= 1801
```

```
      JZ=   46
      GOTO 500
 60 IF (STATIN .NE. 'AVL') GOTO  70
      JX= 7204
      JY= 6439
      JZ=  661
      GOTO 500
 70 IF (STATIN .NE. 'BHM') GOTO  80
      JX= 3378
      JY= 4278
      JZ=  192
      GOTO 500
 80 IF (STATIN .NE. 'BNA') GOTO  90
      JX= 3431
      JY= 7106
      JZ=  184
      GOTO 500
 90 IF (STATIN .NE. 'BVE') GOTO 100
      JX=  816
      JY= -389
      JZ=    0
      GOTO 500
100 IF (STATIN .NE. 'CHA') GOTO 110
      JX= 4788
      JY= 5919
      JZ=  210
      GOTO 500
110 IF (STATIN .NE. 'GSP') GOTO 120
      JX= 7521
      JY= 5861
      JZ=  296
      GOTO 500
120 IF (STATIN .NE. 'HSV') GOTO 130
      JX= 3360
      JY= 5479
      JZ=  196
      GOTO 500
130 IF (STATIN .NE. 'JAN') GOTO 140
      JX=  243
      JY= 2934
      JZ=  101
      GOTO 500
140 IF (STATIN .NE. 'MCN') GOTO 150
      JX= 6288
      JY= 3367
      JZ=  110
      GOTO 500
150 IF (STATIN .NE. 'MEI') GOTO 160
      JX= 1499
      JY= 2924
      JZ=   94
```

```
      GOTO 500
160 IF (STATIN .NE. 'MEM') GOTO 170
      JX=  425
      JY= 5963
      JZ=   87
      GOTO 500
170 IF (STATIN .NE. 'MGM') GOTO 180
      JX= 3711
      JY= 2875
      JZ=   62
      GOTO 500
180 IF (STATIN .NE. 'MOB') GOTO 190
      JX= 1949
      JY= 1089
      JZ=   67
      GOTO 500
190 IF (STATIN .NE. 'MSY') GOTO 200
      JX= 9
      JY= 351
      JZ=  9
      GOTO 500
200 IF (STATIN .NE. 'PNS') GOTO 210
      JX= 2954
      JY=  842
      JZ=   36
      GOTO 500
210 IF (STATIN .NE. 'SPA') GOTO 220
      JX= 7764
      JY= 5891
      JZ=  251
      GOTO 500
220 IF (STATIN .NE. 'TLH') GOTO 230
      JX= 5677
      JY=  779
      JZ=   21
      GOTO 500
230 IF (STATIN .NE. 'TYS') GOTO 240
      JX= 5873
      JY= 6815
      JZ=  299
      GOTO 500

240 TYPE 250,STATIN
250 FORMAT (' YOU BLEW IT AT STATION ',A5)

500 CONTINUE
    RETURN
    END
```

```
      PROGRAM AIRWAY
      INTEGER JX,JY,JZ,TIME,TYPE,VISIBL,LAYERS,WETHRS,IVISC,ICLG,ICLGV,
     +        COVAGE(10),HEIGHT(10),THIN(10),WEATHR(7),PRESSR,TEMP,
     +        DEWPT,MISSNG,INUNIT,OUTUNT
      LOGICAL EOF
      DOUBLE PRECISION INFILE,OUTFIL
      COMMON MISSNG,INUNIT,OUTUNT
      MISSNG= -32768
      EOF= .FALSE.
      TYPE 10
   10 FORMAT (' NAME THE FILE.EXT OF THE INPUT FILE')
      ACCEPT *, INFILE
      TYPE 20
   20 FORMAT (' TYPE THE LOGICAL UNIT NUMBER OF THE INPUT FILE')
      ACCEPT *, INUNIT
      TYPE 30
   30 FORMAT (' TYPE THE OUTPUT FILE.EXT')
      ACCEPT *, OUTFIL
      TYPE40
   40 FORMAT (' TYPE THE LOGICAL UNIT NUMBER OF THE OUTPUT FILE')
      ACCEPT *, OUTUNT
      OPEN (UNIT= INUNIT, FILE= INFILE, ACCESS='SEQIN')
      OPEN (UNIT= OUTUNT, FILE= OUTFIL, ACCESS='SEQOUT')
   50 CALL ID (JX,JY,JZ,TIME,TYPE,VISIBL,LAYERS,WETHRS,IVISC,EOF)
      IF (EOF) GOTO 60
      CALL CLOUDS (LAYERS,ICLG,ICLGV,COVAGE,HEIGHT,THIN)
      CALL WHETHR (WETHRS,WEATHR,PRESSR,TEMP,DEWPT)
      CALL PRINT (JX,JY,JZ,TIME,TYPE,VISIBL,LAYERS,ICLG,
     +           ICLGV,IVISC,WEATHR,COVAGE,HEIGHT,THIN)
      GOTO 50
   60 CONTINUE
      END

      SUBROUTINE ID (JX,JY,JZ,TIME,TYPE,VISIBL,LAYERS,WETHRS,IVISC,EOF)
      INTEGER JX,JY,JZ,TIME,TYPE,VISIBL,LAYERS,WETHRS,IVISC,DATE
      REAL VISIB
      LOGICAL EOF
      DIMENSION TEST(5),LINE(20)
      COMMON MISSNG,INUNIT,OUTUNT
      READ (INUNIT,40,END=20) (TEST(I),I=1,5)
      IF (TEST(4) .EQ. ',') GOTO 10
      IF (TEST(5) .EQ. ',') GOTO 5
      TYPE 4,(TEST(I),I=1,5)
    4 FORMAT (' ERROR ',5A2)
      DO 7 J=1,10
         READ (INUNIT,9) (LINE(I),I=1,20)
         TYPE 11, (LINE(I),I=1,20)
    7 CONTINUE
      STOP
    9 FORMAT (20A1)
   11 FORMAT (1X,20A1)
```

```
 5 REREAD 50, DATE,TIME
   TIME=NEWTIM(TIME)
   READ (INUNIT,60) (TEST(I),I=1,5)
10 REREAD 60, (TEST(I),I=1,5)
   REREAD 70, STATIN,ITYPE,LAYERS,WETHRS,VISIB
   CALL CONVRT (STATIN,JX,JY,JZ,ITYPE,TYPE,VISIB,VISIBL,IVISC)
   IF (TEST(3) .EQ. ' ') LAYERS=MISSNG
   IF (TEST(4) .EQ. ' ') WETHRS=MISSNG
   IF (TEST(5) .EQ. ' ') VISIBL=MISSNG
   GOTO 30
20 EOF=.TRUE.
30 CONTINUE
40 FORMAT (5A1)
50 FORMAT (2I)
60 FORMAT (5A)
70 FORMAT (2A,2I,F)
   RETURN
   END

   INTEGER FUNCTION NEWTIM (TIME)
   INTEGER HOURS,MIN,TIME
   HOURS=TIME/100
   MIN=TIME-(HOURS*100)
   NEWTIM=(HOURS*60)+MIN
   RETURN
   END

   SUBROUTINE CONVRT (STATIN,JX,JY,JZ,ITYPE,TYPE,VISIB,
  +                  VISIBL,IVISC)
   INTEGER JX,JY,JZ,TYPE,TIME,IVISC,HOURS,MIN,VISIBL
   REAL VISIB
   COMMON MISSNG,INUNIT,OUTUNT
   DIMENSION LINE(20)
   IF (STATIN .NE. 'ABY') GOTO 10
        JX= 5821
        JY= 2058
        JZ=   60
        GOTO 500
10 IF (STATIN .NE. 'AGS') GOTO  20
        JX= 7834
        JY= 4169
        JZ=   45
        GOTO 500
20 IF (STATIN .NE. 'AHN') GOTO  30
        JX= 6552
        JY= 4764
        JZ=  247
        GOTO 500
30 IF (STATIN .NE. 'AMG') GOTO  40
        JX= 9314
        JY= 2207
```

AD-A071 452 GEO-ATMOSPHERICS CORP LINCOLN MA F/G 4/2
SENSITIVITY STUDY OF CFAS AND CFAR OBJECTIVE ANALYSIS TECHNIQUE--ETC(U)
FEB 79 W D MOUNT, B R FOW, B D MOUNT DAEA18-76-C-0060

UNCLASSIFIED ERADCOM/ASL-CR-79-0060-1 NL

3 OF 3

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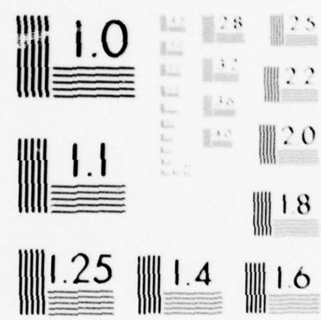

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

```
      JZ=   63
      GOTO 500
 40 IF (STATIN .NE. 'ANB') GOTO  50
      JX= 4214
      JY= 4302
      JZ=  188
      GOTO 500
 50 IF (STATIN .NE. 'AND') GOTO  60
      JX= 7082
      JY= 5396
      JZ=  236
      GOTO 500
 60 IF (STATIN .NE. 'AQQ') GOTO  70
      JX= 5097
      JY=   46
      JZ=   11
      GOTO 500
 70 IF (STATIN .NE. 'ATL') GOTO  80
      JX= 5527
      JY= 4400
      JZ=  315
      GOTO 500
 80 IF (STATIN .NE. 'AYS') GOTO  90
      JX= 7531
      JY= 1801
      JZ=   46
      GOTO 500
 90 IF (STATIN .NE. 'AVL') GOTO 100
      JX= 7204
      JY= 6439
      JZ=  661
      GOTO 500
100 IF (STATIN .NE. 'BHM') GOTO 110
      JX= 3378
      JY= 4278
      JZ=  192
      GOTO 500
110 IF (STATIN .NE. 'BNA') GOTO 120
      JX= 3431
      JY= 7106
      JZ=  184
      GOTO 500
120 IF (STATIN .NE. 'BTR') GOTO 130
      JX= -837
      JY=  989
      JZ=   23
      GOTO 500
130 IF (STATIN .NE. 'BVE') GOTO 140
      JX=  816
      JY= -389
      JZ=    0
```

```
      GOTO 500
140 IF (STATIN .NE. 'CEW') GOTO 150
      JX= 3609
      JY= 1194
      JZ=   56
      GOTO 500
150 IF (STATIN .NE. 'CHA') GOTO 160
      JX= 4788
      JY= 5919
      JZ=  210
      GOTO 500
160 IF (STATIN .NE. 'CKV') GOTO 170
      JX= 2804
      JY= 7642
      JZ=  166
      GOTO 500
170 IF (STATIN .NE. 'CSG') GOTO 180
      JX= 5088
      JY= 3133
      JZ=  120
      GOTO 500
180 IF (STATIN .NE. 'CSV') GOTO 190
      JX= 4875
      JY= 6938
      JZ=  570
      GOTO 500
190 IF (STATIN .NE. 'DHN') GOTO 200
      JX= 4621
      JY= 1794
      JZ=  113
      GOTO 500
200 IF (STATIN .NE. 'DYR') GOTO 210
      JX=  983
      JY= 7021
      JZ=  105
      GOTO 500
210 IF (STATIN .NE. 'FTY') GOTO 220
      JX= 5446
      JY= 4546
      JZ=  257
      GOTO 500
220 IF (STATIN .NE. 'GLH') GOTO 230
      JX= -556
      JY= 4256
      JZ=   40
      GOTO 500
230 IF (STATIN .NE. 'GNV') GOTO 240
      JX= 7731
      JY=   86
      JZ=   50
      GOTO 500
```

```
240 IF (STATIN .NE. 'GSP') GOTO 250
        JX= 7521
        JY= 5861
        JZ=  296
        GOTO 500
250 IF (STATIN .NE. 'GWO') GOTO 260
        JX=  173
        JY= 4250
        JZ=   41
        GOTO 500
260 IF (STATIN .NE. 'HSV') GOTO 270
        JX= 3360
        JY= 5479
        JZ=  196
        GOTO 500
270 IF (STATIN .NE. 'JAN') GOTO 280
        JX=  243
        JY= 2934
        JZ=  101
        GOTO 500
280 IF (STATIN .NE. 'JBR') GOTO 290
        JX= -151
        JY= 6853
        JZ=  805
        GOTO 500
290 IF (STATIN .NE. 'MCB') GOTO 300
        JX= -155
        JY= 1780
        JZ=  143
        GOTO 500
300 IF (STATIN .NE. 'MCN') GOTO 310
        JX= 6288
        JY= 3367
        JZ=  110
        GOTO 500
310 IF (STATIN .NE. 'MEI') GOTO 320
        JX= 1499
        JY= 2924
        JZ=   94
        GOTO 500
320 IF (STATIN .NE. 'MEM') GOTO 330
        JX=  425
        JY= 5963
        JZ=   87
        GOTO 500
330 IF (STATIN .NE. 'MGM') GOTO 340
        JX= 3711
        JY= 2875
        JZ=   62
        GOTO 500
340 IF (STATIN .NE. 'MGR') GOTO 350
```

```
      JX= 6200
      JY= 1569
      JZ=   88
      GOTO 500
350 IF (STATIN .NE. 'MKL') GOTO 360
      JX= 1410
      JY= 6549
      JZ=  129
      GOTO 500
360 IF (STATIN .NE. 'MOB') GOTO 370
      JX= 1949
      JY= 1089
      JZ=   67
      GOTO 500
370 IF (STATIN .NE. 'MSL') GOTO 380
      JX= 2582
      JY= 5592
      JZ=  171
      GOTO 500
380 IF (STATIN .NE. 'MSY') GOTO 390
      JX=    9
      JY=  351
      JZ=    9
      GOTO 500
390 IF (STATIN .NE. 'NEW') GOTO 400
      JX=  220
      JY=  400
      JZ=    3
      GOTO 500
400 IF (STATIN .NE. 'PNS') GOTO 410
      JX= 2954
      JY=  842
      JZ=   36
      GOTO 500
410 IF (STATIN .NE. 'RMG') GOTO 420
      JX= 4833
      JY= 5162
      JZ=  196
      GOTO 500
420 IF (STATIN .NE. 'SFB') GOTO 430
      JX= 8769
      JY= -886
      JZ=    2
      GOTO 500
430 IF (STATIN .NE. 'SPA') GOTO 440
      JX= 7764
      JY= 5891
      JZ=  251
      GOTO 500
440 IF (STATIN .NE. 'TCL') GOTO 450
      JX= 2572
```

```
      JY= 3910
      JZ=   57
      GOTO 500
450 IF (STATIN .NE. 'TIX') GOTO 460
      JX= 9227
      JY=-1161
      JZ=   11
      GOTO 500
460 IF (STATIN .NE. 'TLH') GOTO 470
      JX= 5677
      JY=  779
      JZ=   21
      GOTO 500
470 IF (STATIN .NE. 'TUP') GOTO 480
      JX= 1520
      JY= 5068
      JZ=  110
      GOTO 500
480 IF (STATIN .NE. 'TYS') GOTO 490
      JX= 5873
      JY= 6815
      JZ=  299
      GOTO 500
490 IF (STATIN .NE. 'VLD') GOTO 495
      JX= 6705
      JY= 1252
      JZ=   66
      GOTO 500
495 TYPE 497,STATIN
497 FORMAT (' STATIN ERROR WITH',A5)
    DO 7 J=1,10
       READ (INUNIT,9) (LINE(I),I=1,20)
       TYPE 11, (LINE(I),I=1,20)
  7 CONTINUE
    STOP
  9 FORMAT (20A1)
 11 FORMAT (1X,20A1)
500 IF (ITYPE .EQ. 'A') TYPE=1
    IF (ITYPE .EQ. 'S') TYPE=-1
    VISIBL=INT(VISIB*100.)
    IVISC=MISSNG
    RETURN
    END
    SUBROUTINE CLOUDS (LAYERS,ICLG,ICLGV,COVAGE,HEIGHT,THIN)
    INTEGER LAYERS,ICLG,ICLGV,COVAGE(10),HEIGHT(10),THIN(10),LAYEI
    DIMENSION TEST(5)
    COMMON MISSNG,INUNIT,OUTUNT
    ICLG=MISSNG
    ICLGV=MISSNG
    DO 10 I=1,10
       THIN(I)=MISSNG
```

```
      COVAGE(I)=MISSNG
      HEIGHT(I)=MISSNG
10 CONTINUE
   IF (LAYERS .NE. MISSNG) GOTO 20
   READ (INUNIT,50) (TEST(I),I=1,3)
   GOTO 40
20 DO 40 LAYER=1,LAYERS
      READ (INUNIT,50) (TEST(I),I=1,3)
      REREAD 60, HEIGHT(LAYER), COVRGE, HOWMES
      IF (TEST(1) .EQ. ' ') HEIGHT(LAYER)=MISSNG
      IF (TEST(2) .EQ. ' ') COVRGE=MISSNG
      IF (TEST(3) .EQ. ' ' .OR. ICLG .NE. MISSNG) GOTO 30
      ICLG=LAYER*10
      IF (HOWMES .EQ. 'M' .OR. HOWMES .EQ. 'MV') ICLG=ICLG+1
      IF (HOWMES .EQ. 'E' .OR. HOWMES .EQ. 'EV') ICLG=ICLG+5
      IF (HOWMES .EQ. 'MV' .OR. HOWMES .EQ. 'EV') ICLGV=1
30    IF (COVRGE .EQ. ' ') GOTO 40
      IF (COVRGE .EQ. 'CLR' .OR. COVRGE .EQ. '-CLR') COVAGE(LAYER)=0
      IF (COVRGE .EQ. 'SCT' .OR. COVRGE .EQ. '-SCT') COVAGE(LAYER)=3
      IF (COVRGE .EQ. 'BKN' .OR. COVRGE .EQ. '-BKN') COVAGE(LAYER)=6
      IF (COVRGE .EQ. 'OVC' .OR. COVRGE .EQ. '-OVC') COVAGE(LAYER)=8
      IF (COVRGE .EQ. '-CLR' .OR. COVRGE .EQ. '-SCT' .OR.
  +         COVRGE .EQ. '-BKN' .OR. COVRGE .EQ. '-OVC') THIN(LAYER)=1
40 CONTINUE
50 FORMAT (3A)
60 FORMAT (I,2A)
   RETURN
   END
   SUBROUTINE WHETHR (WETHRS,WEATHR,PRESSR,TEMP,DEWPT)
   INTEGER WETHRS,WEATHR(7),PRESSR,TEMP,DEWPT
   DIMENSION TEST(3)
   COMMON MISSNG,INUNIT,OUTUNT
   DO 10 I=1,7
      WEATHR(I)=MISSNG
10 CONTINUE
   IF (WETHRS .NE. 0 .AND. WETHRS .NE. MISSNG)
  +     READ (INUNIT,20) (WEATHR(I),I=1,WETHRS)
   READ (INUNIT,30) (TEST(I),I=1,3)
   REREAD 40, PRESSR,TEMP,DEWPT
   IF (TEST(1) .EQ. ' ') PRESSR=MISSNG
   IF (TEST(2) .EQ. ' ') TEMP=MISSNG
   IF (TEST(3) .EQ. ' ') DEWPT=MISSNG
20 FORMAT (7I)
30 FORMAT (3A)
40 FORMAT (3I)
   RETURN
   END
   SUBROUTINE PRINT (JX,JY,JZ,TIME,TYPE,VISIBL,LAYERS,ICLG,
  +                  ICLGV,IVISC,WEATHR,COVAGE,HEIGHT,THIN)
   INTEGER JX,JY,JZ,TIME,TYPE,VISIBL,LAYERS,ICLG,ICLGV,OUTUNT,
  +        IVISC,WEATHR(7),COVAGE(10),HEIGHT(10),THIN(10)
```

```
      COMMON MISSNG,INUNIT,OUTUNT
      WRITE (OUTUNT,10) JX,JY,JZ,TIME,TYPE,VISIBL,LAYERS
      WRITE (OUTUNT,10) ICLG,ICLGV,IVISC
      WRITE (OUTUNT,10) (WEATHR(I),I=1,7)
      WRITE (OUTUNT,20) (COVAGE(I),MISSNG,HEIGHT(I),THIN(I),I=1,LAYERS)
   10 FORMAT (8I10)
   20 FORMAT (4I10)
      RETURN
      END
```

```
CFAS*CFASS(1).NEWUTM
      REAL LAT,LONG,NORTH
      INTEGER UTMX
      DIMENSION UTMX(50)/5821,7834,5552,9314,4214,7082,5097,5527,7531,
     $7204,3378,3431,-837,316,3609,4738,5083,4875,4621,983,5446,-555,
     $7731,7521,173,3360,243,-151,-155,6288,1499,425,3711,1410,1949,
     $2582,9,220,2954,4833,7764,2577,5677,1520,5673,6705,3227,8769,6200,
     $2804/
      DIMENSION  LAT(50)/31.53333,33.36667,33.95,31.53333,33.58333,34.5,
     $29.73333,33.65,31.25,35.43333,33.56667,36.11667,30.53333,29.33333,
     $30.78333,35.03333,32.51667,35.97,31.31667,38.01667,33.78333,
     $33.48333,29.7,34.9,33.5,34.65,32.31667,35.83333,31.26667,32.7,
     $32.33333,35.05,32.3,35.6,30.58333,34.75,29.98333,30.03333,30.46667
     $,34.35,34.91667,33.23333,30.38333,34.16667,35.81667,30.78333,
     $28.516667,28.78333,31.08333,36.6/
      DIMENSION  LONG(50)/84.18333,81.96667,83.31667,82.51667,85.85,
     $82.71667,84.98333,84.43333,82.4,82.53333,86.75,86.68333,91.15,89.4
     $,86.51667,85.2,84.93333,85.08333,85.45,89.4,84.51667,90.98333,
     $82.26667,82.21667,90.2,96.75667,90.08333,90.65,90.46667,83.65,
     $88.75,89.98333,86.4,88.91667,88.25,87.01667,90.25,90.03333,87.2,
     $85.16667,81.95,97.61667,84.36667,88.76667,83.98333,83.29333,80.8,
     $81.25,83.8,87.38333/
      DIMENSION NUTMX(50), NUTMY(50), LINE(7), LINE1(14)
      DATA CLAT/30.683333/, CLONG/89.00/, CNTMR/85.5/
      CALL UTM(CLONG,CLAT,CEAST,CNORTH,CNTMR)
      DO 5 I=1,50
      CALL UTM(LONG(I),LAT(I),EAST,NORTH,CNTMR)
      RELX=(EAST-CEAST)*1000.
      NUTMX(I)=RELX
      RELY=(NORTH-CNORTH)*1000.
      NUTMY(I)=RELY
      WRITE (6,3000) I,NUTMX(I),NUTMY(I)
 3000 FORMAT (10X,'STATION # ',I3,' NUTMX=',I5,' NUTMY=',I6)
    5 CONTINUE
   10 READ (11,80,END=40) (LINE(J),J=1,7)
      DO 15 I=1,50
      IPT=I
      IF (LINE(1) .EQ. UTMX(I)) GOTO 20
   15 CONTINUE
      WRITE (6,2000) LINE(1),LINE(2)
      STOP
```

```
   20 LINE(1)=NUTMX(IPT)
      LINE(2)=NUTMX(IPT)
      IF (LINE(7) .LT. 0) GO TO 30
      WRITE (12,80) (LINE(J),J=1,7)
      LINES=LINE(7) + 2
      DO 25 I=1,LINES
      READ (11,90) (LINE1(J),J=1,14)
      WRITE (12,90) (LINE1(J),J=1,14)
   25 CONTINUE
      GOTO 10
   30 LINE(7)=0
      WRITE (12,80) (LINE(J),J=1,7)
      LINES=7
      DO 35 I=1,LINES
      READ (11,90) (LINE1(J),J=1,14)
      IF (I .EQ. LINES) GOTO 35
      WRITE (12,90) (LINE1(J),J=1,14)
   35 CONTINUE
      GOTO 10
   40 CEAST=CEAST*100.
      CNORTH=CNORTH*100.
      WRITE (6,2010) CNORTH,CEAST,CNTMP
      STOP
   80 FORMAT(7I10)
   90 FORMAT(14A5)
 2000 FORMAT(5X,'NO STATION WITH COORDINATES X=',I5, ', Y=',I5)
 2010 FORMAT(5X,'DATA YZRO/',F7.2,'/,XZRO/',F7.2,2X,'/CNTMP/',F6.2,'/')
      END
```

```
CFAS*CFASS(1).CFMAIN/STAT1
C       CFMAIN
C       TEST DRIVER FOR THE CFAS
        INTEGER TASK,TIME,TYMOLD,CFASD,GRDPV,GRD
        COMMON /IDAT/ JX,JY,JZ,ITIME,IOBC,ITYPE,IVALU,NICLC,NCEIL,NVV,
       *MINBAS,MAXTOP,MSPWE,LCOV(9),ICL,ITSC,ICM,ICH,ICTS(10),NWEA(7),IPW,
       *IWD,IWS,IPPP,ITT,ITD,IVIS,NH,IH,NS(10),IHS(10),ITHN(10),ICLG,ICLGV
       *,IVISC,NDUSE(59)
        COMMON /CLOCKT/NOWTYM,LASTSK
        COMMON /MAP/ XREF,YREF,CMRD
        COMMON /OUTPT/IBEG,IEND,JBEG,JEND


        DIMENSION IDAT(143),JDAT(143),IZ(30),IP(30),IT(30),IDD(30),
       *CFASD(6010),GRDPV(20,20,15),IDENT(10),Z(30),P(30),T(30),DD(30)
        EQUIVALENCE (IDAT(1),JX),(IDAT(23),ICL,IZ(1)),(IDAT(53),NS(1),IP(1
       *)),(IDAT(83),ICLG,IT(1)),(IDAT(113),IDD(1)),(IDAT(143),NRPL),
       *(CFASD(11),GRDPV(1,1,1)),(CFASD(1),IDENT(1))
        DATA MISS/-32768/
        DATA NCFF/4/
        DATA GRD/25/,LNTHX/500/,LNTHY/500/
        DATA XZRO/154.66/,YZRO/3399.56/,CNTMER/35.5/
        DATA NOBWRT/22/, KFIN0/5/, KFIN1/6/, NWDREC/44/

        LAST=0
        NOP=1
        NPRT=0
        LASTSK = 0
        XREF=XZRO
        YREF=YZRO
        CMRD=CNTMER
        IGP=LNTHX/GRD
        JGP=LNTHY/GRD
        ICFDB=IGP*JGP*15+10
      5 READ  (5,1000) TASK,NPRT,NOWTYM
   1000 FORMAT(8I10)
        WRITE  (6,2000) TASK,NPRT,NOWTYM
        MFG=1
   2000 FORMAT('1',5X,'TASK=',I4,5X,'NPRT=',I4,5X,'NOWTYM=',I5)
        GO TO (130,10,200,200),TASK
     10 DO 20 I=1,143
```

```
   20 IDAT(I)=MISS
      READ (5,1000,END=140) JX,JY,JZ,ITIME,ITYPE,IVIS,NC
      NOB=NOB + 1
      MFC=IABS(ITYPE/10)
      ITYPE=MOD(ITYPE,10)
      MT=IABS(ITYPE)
      GO TO (30,30,30,30,100),MT
   30 IF(NPRT .EQ. 0) GO TO 33
      WRITE (6,2005)
 2005 FORMAT(/)
      WRITE (6,2010)JX,JY,JZ,ITIME,ITYPE,IVIS,NC
 2010 FORMAT(4X,'JX',8X,'JY',8X,'JZ',6X,'ITIME',5X,'ITYPE',6X,'IVIS',6X,
     *'NC'/7(2X,I6,2X)/)
   33 GO TO (35,50,40,80,100),MT
   35 READ (5,1000) ICLG,ICLGV,IVISC
      IF(NPRT .EQ. 0) GO TO 50
      WRITE(6,2020) ICLG,ICLGV,IVISC
 2020 FORMAT(3X,'ICLG',5X,'ICLGV',5X,'IVISC'/3(2X,I6,2X)/)
      GO TO 50
   40 READ (5,1000) ITSC,NH,ICL,IH,ICM,ICH,IPW
      IF(NPRT .EQ. 0) GO TO 50
      WRITE(6,2030) ITSC,NH,ICL,IH,ICM,ICH,IPW
 2030 FORMAT(3X,'ITSC',7X,'NH',7X,'ICL',8X,'IH',7X,'ICM',7X,'ICH',7X,'IP
     *W'/7(2X,I6,2X)/)
   50 READ (5,1000) (NWEA(I),I=1,7)
      IF(NPRT .EQ. 0) GO TO 55
      WRITE (6,2035) (NWEA(I),I=1,7)
 2035 FORMAT(2X,'NWEA(1)',3X,'NWEA(2)',3X,'NWEA(3)',3X,'NWEA(4)',3X,'NWE
     *A(5)',3X,'NWEA(6)',3X,'NWEA(7)'/7(3X,I4,3X)/)
   55 IF(NC .EQ. 0) GO TO 110
      READ  (5,1010) (NS(I),ICTS(I),IHS(I),ITHN(I),I=1,NC)
 1010 FORMAT(4I10)
      IF(NPRT .EQ. 0) GO TO 110
      WRITE(6,2040)
 2040 FORMAT(4X,'NS',9X,'ICTS',8X,'IHS',9X,'ITHN'/)
      WRITE(6,2050)(NS(I),ICTS(I),IHS(I),ITHN(I),I=1,NC)
 2050 FORMAT(4(2X,I6,4X))
      GO TO 110
   80 IF(NPRT .EQ. 0) GO TO 85
      WRITE (6,2005)
      WRITE(6,2060) JX,JY,JZ,ITIME,ITYPE
```

```
 2060 FORMAT(4X,'JX',8X,'JY',8X,'JZ',6X,'ITIME',5X,'ITYPE'/5(2X,I6,2X)/)
   85 I=0
   90 I=I+1
      READ  (5,1000) IZ(I),IP(I),II(I),IDD(I)
      Z(I)=FLOAT(IZ(I))
      II(I)=II(I)+2732
      P(I)=FLOAT(IP(I))*.1
      P(I)=ABS(P(I))
      T(I)=FLOAT(II(I))*.1
      DD(I)=FLOAT(IDD(I))*.1
      IF((IP(I) .GE. 0) .OR. (IP(I) .EQ. MISS)) GO TO 90
      NRPL=I
      IF(NPRT .EQ. 0) GO TO 110
      WRITE (6,2070)
 2070 FORMAT(9X,'IZ',10X,'IP',10X,'II',10X,'IDD',10X,'Z',12X,'P',11X,'T'
     *11X,'DD'/)
      WRITE(6,2080) (IZ(I),IP(I),II(I),IDD(I),Z(I),P(I),T(I),DD(I),I=1,
     *NRPL)
 2080 FORMAT(3X,4I12,4F12.2)
      GO TO 110
  100 IF(NPRT .EQ. 0) GO TO 105
      WRITE (6,2005)
      WRITE (6,2060) JX,JY,JZ,ITIME,ITYPE
  105 READ  (5,1000) NICLC,NCEIL,NVV,MINBAS,MAXTOP,MSPWE,(LCOV(I),I=1,9)
      IF(NPRT .EQ. 0) GO TO 110
      WRITE (6,2090) NICLC,NCEIL,NVV,MINBAS,MAXTOP,MSPWE,(LCOV(I),I=1,9)
 2090 FORMAT(3X,'NICLC',5X,'NCEIL',5X,'NVV',5X,'MINBAS',4X,'MAXTOP',4X,'
     *MSPWE',4X,'LCOV(1)',3X,'LCOV(2)'/3(2X,I6,2X)//2X,'LCOV(3)',3X,'LCO
     *V(4)',3X,'LCOV(5)',3X,'LCOV(6)',3X,'LCOV(7)',3X,'LCOV(8)',3X,'LCOV
     *(9)'/7(2X,I6,2X)///)
  110 DO 120 J=1,143
  120 JDAT(J)=IDAT(J)
      IF (LASTCK .EQ. 0 .AND. TACK .EQ. 2) LASTCK=3
  130 CALL EXEC1(TACK,TIME,JDAT,LAST,IYMOLD,NO3)
      IF (MFR .LE. 0) GO TO 10
  140 DO 150 I=2,44
  150 JDAT(I)=0
      JDAT(1)=NOR
      CALL BLKOUT(NWORDS,JDAT,1,KFIN1,ISTAT)
  200 STOP
      END
```

CFAS*CFASS(1).EXEC1/STAT1

```
      SUBROUTINE EXEC1(TASK,TIME,OBSRPT,LAST,TYMOLD,NOBR)
C
C     INPUT DATA (FORMAL PARAMETERS)

C     TASK = TASK REQUESTED BY FRAMS
C                 1 = SET UP THE OBS/REP STORAGE FILES
C                 2 = INPUT OBS/REP
C                 3 = CREATE A NEW CFDB
C                 4 = UPDATE THE LATEST CFDB ON FILE
C                 5 = OUTPUT UPDATED COMMON BLOCK BASE TO MASS STORAGE
C     TIME = REFERENCE TIME OF CFDB CREATION OR UPDATE
C     OBSRPT = OBS/REP
C     LAST = SEQUENCE NUMBER OF THE LAST OBS/REP STORED.
C     TYMOLD = TIME OF OLDEST OBS/REP TO BE USED IN A CREATION OR UPDATE

C     DATA STATEMENTS
C
C     LCFILE = LOGICAL DEVICE NO. OF TEMPORARY STORAGE FILE USED IN
C                  'COMOBR'.
C     NOBR = MAXIMUM NUMBER OF OBS/REP THAT CAN BE USED IN A CREATION
C              OR UPDATE.

C     OBS/REP INPUT ELEMENTS

C     IX = X DISTANCE OF OBS/REP SITE FROM IXREF, HECTOMETERS.
C     IY = Y DISTANCE OF OBS/REP SITE FROM IYREF, HECTOMETERS.
C     IZ = OBS/REP SITE ELEVATION ABOVE MEAN SEA LEVEL, METERS.
C     ITIME = TIME OF OBS/REP (0-1440)
C     ITYPE = TYPE OF OBS/REP
C                   1 = AIRWAYS, -1 IF A SPECIAL.
C                   2 = METAR, -2 IF A SPECIAL (SPECI)
C                   3 = SYNOP
C                   4 = UPPER AIR (RAOB), -4 IF A SPECIAL
C                   5 = AFGWC 3D-NEPH OUTPUT
C     FOR EXPLANATION OF REMAINING OBS/REP INPUT ELEMENTS CONSULT
C     LISTINGS OF SUBROUTINE SFDINT IF A SURFACE OBS/REP OR
C     SUBROUTINE UADINT IF AN UPPER AIR OBS/REP.

C     CFDB PARAMETERS DETERMINED FROM OBS/REP.
```

```
C     IOBC = SEQUENCE NO. OF OBS/REP.
C     IVALU = CFDB INFORMATION VALUE OF THE OBS/REP
C     NTCLC = TOTAL CLOUD COVER, (00 TO 100)
C     NCEIL = HEIGHT OF CEILING LAYER (AGL), DEKAMETERS. MINUS IF A
C             VARIABLE CEILING. LAST DIGIT OF NCEIL INDICATES THE
C             METHOD BY WHICH THE CEILING WAS DETERMINED.
C                  1 = MEASURED
C                  2 = AIRCRAFT
C                  3 = BALLOON
C                  4 = RADAR
C                  5 = ESTIMATED
C                  6 = INDEFINITE
C     NVV = PREVAILING SURFACE VISIBILITY, METERS. MINUS IF VARIABLE.
C     MINBAS = HEIGHT OF BASE OF LOWEST CLOUD, DEKAMETERS.
C     MAXTOP = HEIGHT OF TOP OF HIGHEST CLOUD THAT COULD BE DETERMINED
C             FROM OBS/REP ELEMENTS, DEKAMETERS.
C     MSPWE = MOST SIGNIFICANT PRESENT WEATHER ELEMENT. (WMO CODE 4677)
C     LCOV(I) = PERCENT CLOUD COVER IN THE CFDB LAYERS, (00 TO 100).
C                                  CFDB LAYERS
C                  LAYER           BOTTOM                     TOP
C                    1        0 FEET      0 METERS    150 FEET      45 METERS
C                    2      150          45           300           91
C                    3      300          91           600          183
C                    4      600         183          1000          305
C                    5     1000         305          2000          610
C                    6     2000         610          3500         1067
C                    7     3500        1067          5000         1524
C                    8     5000        1524          6500         1981
C                    9     6500        1981         10000         3048


      INTEGER TASK,TIME,OBSRPT,TYMOLD

      COMMON /CLOCKT/NOWTYM,LASTSK
      COMMON /OBSREP/IX,IY,IZ,ITIME,IOBC,ITYPE,IVALU,NTCLC,NCEIL,NVV,
     *MINBAS,MAXTOP,MSPWE,LCOV(9),ICL,ITSC,ICM,ICH,ICTS(10),NWEA(7),IRW,
     *NOUSE(99)
      DIMENSION OBSRPT(143),KOBR(143),F1(4),F2(7),I1(17)
      INCLUDE BASE,LIST

      EQUIVALENCE (KOBR(1),IX)
```

```
      DATA LSFILE/3/,NOPR/100/
      DATA KNUMBR /0/
      DATA IPRT/6/
      DATA NOBWRT/22/, KFIN0/5/, KFIN1/6/, NWDREC/44/
      DATA MISS/-32768/

      GO TO (10,20,70,70),TASK
C
C     COME HERE TO INITIALIZE AND SET UP OBS/REP STORAGE FILES
C
   10 CALL BEGIN
      IOBC=0
      RETURN
C
C     COME HERE TO INTERPRET AND FILE AN OBS/REP.
C
   20 DO 25 K=1,143
   25 KOBR(K)=OBSRPT(K)
      IOBC=LAST+1
      NIR=IABS(ITYPE)
      GO TO (30,30,30,40,50),NIR
C
C     COME HERE TO INTERPRET A SURFACE OBS/REP
C
   30 CALL SFCINT
      GO TO 60
C
C     COME HERE TO INTERPRET AN UPPER AIR OBS/REP.
C
   40 CALL UADINT
      GO TO 60
C
C     COME HERE TO PROCESS CLOUD-FOG DATA FROM THE AFGWC 3D-NEPH OUTPUT
C
   50 CALL AFDINT
   60 DO 65 K=1,44
   65 OBSRPT(K)=KOBR(K)
      IF (SENSE SWITCH 1) 67,68
   67 CALL BLKOUT(NOBWRT,OBSRPT,IOBC,KFIN0,IDTAT)
   68 CONTINUE
```

```
      CALL BLKOUT(NWDREC,OBSRPT,NOB,KFINI,ISTAT)
      LAST=IOBC
      IF(LAST .EQ. NOBR) LAST=0
   70 RETURN
      END
```

```
CFAF*CFACC(1).INTPPT
C     PRINTS INTERPRETED OBS.

      DIMENSION JDAT(44)
      DATA NOBWPT/22/, KFINO/5/, KFIN2/7/, NWOREC/44/

   10 CALL BLKIN(NWOREC,JDAT,1,KFIN2,ISTAT)
      NOB=JDAT(1)
      WRITE (6,3000) NOB
      NEND=NOB+1
      DO 155 NN=2,NEND
      CALL BLKIN(NWOREC,JDAT,NN,KFIN2,ISTAT)
 3000 FORMAT('1',10X,'NUMBER OF OBSERVATIONS INTERPRETED =',I4,
     *       /'       IX      IY      IZ  ITIME IOPC ITYPE IVALU NTCLC   NCEIL
     * NVV  MINBAS MAXTOP MSPWE  LAY1 LAY2 LAY3 LAY4 LAY5 LAY6 LAY7 LAY8
     * LAY9')
      IF (MOD(NN,50) .EQ. 0) WRITE (6,3000) NOB
  155 WRITE (6,3010) (JDAT(LJM),LJM=1,22)
 3010 FORMAT(3X,I5,1X,I5,1X,I5,2X,I4,1X,I4,2X,I3,3X,I2,3X,6(I5,1X),1X,9(
     *I4,1X))
      STOP GOOD
      END
```

```
CFAC*CFASS(1).OBSTIM
C     READS AN INPUT FILE OF INTERPRETED OBS/REP AND SENDS TO THE OUTPUT
C     FILE THOSE WHOSE OB TIMES WERE .LE. INEW AND .GE. TOLD.

      INTEGER INEW,TOLD
      COMMON /CLOCKT/NOWTYM
      DIMENSION JDAT(44),INFILE(2),OUTFIL(2)
      DATA NOBWPT/22/, KFINO/5/, KFIN2/7/, NWDREC/44/

      MM=0
      READ (5,1000) INEW,TOLD,INFILE,OUTFIL
      NOWTYM=INEW
      NN=0
   10 CALL BLKIN(NWDREC,JDAT,1,KFIN2,ISTAT)
      NOB=JDAT(1)
      WRITE (6,2000) INFILE,NOB,OUTFIL,INEW,TOLD
      WRITE (6,2010) INFILE,OUTFIL
   15 NN=NN + 1
      NC=NN + 1
      CALL BLKIN(NWDREC,JDAT,NC,KFIN2,ISTAT)
      IF (ITYMDF(INEW,JDAT(4)) .LT. 0) GO TO 160
      IF (ITYMDF(JDAT(4),TOLD) .LT. 0) GO TO 160
      MM=MM+1
      MS=MM+1
      CALL BLKOUT(NWDREC,JDAT,MS,KFINO,ISTAT)
      IF (MOD(MM,50) .EQ. 0) WRITE(6,2010) INFILE,OUTFIL
      WRITE (6,2020) (JDAT(LJM),LJM=1,22)
  160 CONTINUE
      IF (NN .LT. NOB) GO TO 15
      DO 170 I=2,44
  170 JDAT(I)=-32768
      JDAT(1)=MM
      CALL BLKOUT(NWDREC,JDAT,01,KFINO,ISTAT)
      WRITE (6,2030) INFILE,OUTFIL,MM
      STOP 6000
 1000 FORMAT(2I10,10X,2A6,8X,2A6)
 2000 FORMAT(10X,'INPUT FILE NAME IS ',2A6//
     *10X,'NO. OF INTERPRETED OBS/REP IN THE INPUT FILE =',I6//
     *10X,'OUTPUT FILE NAME IS ',2A6//
     *10X,'TIME OF MOST RECENT OBS/REP SENT TO THE OUTPUT FILE =',I6//
     *10X,'TIME OF OLDEST OBS/REP SENT TO THE OUTPUT FILE =',I6)
```

```
2010 FORMAT('1',10X,'LIST OF INTERPRETED OBS/REP SENT FROM ',2A6,' TO '
    *,2A6 /'      IX     IY     IZ  ITIME TOPC ITYPE IVALU NTCLC  NCOIL
    * NVV  MINRAD MAXICP MERWE  LAY1 LAY2 LAY3 LAY4 LAY5 LAY6 LAY7 LAY8
    * LAY9')
2020 FORMAT(3X,I5,1X,I5,1X,I5,2X,I4,1X,I4,2X,I3,3X,I2,2X,5(I6,1X),1X,9(
    *I4,1X))
2030 FORMAT(/10X,' TOTAL NUMBER OF INTERPRETED OBS/REP SENT FROM FILE '
    *,2A6,' TO FILE ',2A6,' WAS ',I5)
     END
```

```
CFAS*CFASS(1).STDENS
C     READS AN INPUT FILE OF INTERPRETED OBS?/REP AND WRITES TO AN OUTPUT
C     FILE THOSE TAKEN AT STATIONS BELONGING TO A SET OF STATIONS WHICH
C     CONSTITUTE 3/4, 1/2, 1/4, 1/8, OR 1/16 OF THE FULL STATION DENSITY
C     OR A SILENT AREA SET.
      DIMENSION JDAT(44), INFILE(2), OUTFIL(2)
      INTEGER X
      LOGICAL KEEP
      DATA NWDREC/44/, NINFI/1/, NOTFI/2/
      MM=0
      NN=1
      READ (5,1000) ISTDEN, INFILE, OUTFIL
      STADEN=FLOAT(ISTDEN)/10000.
   10 CALL BLKIN(NWDREC,JDAT,1,NINFI,ISTAT)
      NOB=JDAT(1)
      WRITE (6,2000) INFILE,NOB,OUTFIL,STADEN
   15 NN=NN + 1
      CALL BLKIN(NWDREC,JDAT,NN,NINFI,ISTAT)
      X = JDAT(1)
      KEEP=.FALSE.
      IF (ISTDEN .EQ. 7500) GO TO 30
      IF (ISTDEN .EQ. 5000) GO TO 40
      IF (ISTDEN .EQ. 2500) GO TO 50
      IF (ISTDEN .EQ. 1250) GO TO 60
      IF (ISTDEN .EQ.  625) GO TO 70
C     SILENT AREA
      IF (X .LE. 2375) KEEP = .TRUE.
      GO TO 80
C     3/4 DENSITY
   30 CONTINUE
      IF (X .EQ. 4503 .OR. X .EQ. 5371 .OR. X .EQ. 5186 .OR. X .EQ. 3028
     +.OR.X .EQ. 3853 .OR. X .EQ. 4342 .OR. X .EQ. 2288 .OR. X .EQ.-2070
     +.OR.X .EQ. 3627 .OR. X .EQ. 3885 .OR. X .EQ. 3400 .OR. X .EQ. -151
     +.OR.X .EQ. 4263 .OR. X .EQ. 6753 .OR. X .EQ.-1014 .OR. X .EQ. 2192
     +.OR.X .EQ. 5082 .OR. X .EQ.  293 .OR. X .EQ. -736 .OR. X .EQ. 2506
     +.OR.X .EQ.  718 .OR. X .EQ. 1415 .OR. X .EQ.-1231 .OR. X .EQ. 1381
     +.OR.X .EQ. 4442 .OR. X .EQ. 4723 .OR. X .EQ. 5474)  KEEP = .TRUE.
      GO TO 80
C     1/2 DENSITY
   40 CONTINUE
      IF (X .EQ. -151 .OR. X .EQ. 2283 .OR. X .EQ. 5353 .OR. X .EQ. 1415
```

```
     +.OR.X .EQ. 3028 .OR. X .EQ. 1318 .OR. X .EQ. 3885 .OR. X .EQ. 2506
     +.OR.X .EQ. 6186 .OR. X .EQ. 3400 .OR. X .EQ. 4442 .OR. X .EQ.-1231
     +.OR.X .EQ.  293 .OR. X .EQ. 2192 .OR. X .EQ. 4342 .OR. X .EQ.-1314
     +.OR.X .EQ. 3853 .OR. X .EQ.-2070 .OR. X .EQ. 6046)  KEEP = .TRUE.
      GO TO 80
C     1/4 DENSITY
   50 CONTINUE
      IF (X .EQ. 2288 .OR. X .EQ. 2506 .OR. X .EQ. 3400 .OR. X .EQ.  293
     +.OR.X .EQ. 2192 .OR. X .EQ. 4342 .OR. X .EQ.-1014 .OR. X .EQ. 3853
     +.OR.X .EQ.-2070 .OR. X .EQ. 6046)  KEEP = .TRUE.
      GO TO 80
C     1/8 DENSITY
   60 CONTINUE
      IF (X .EQ. 2506 .OR. X .EQ. 2192 .OR. X .EQ. 4342 .OR.
     +    X .EQ.-1014 .OR. X .EQ. 3853)  KEEP = .TRUE.
      GO TO 80
C     1/16 DENSITY
   70 CONTINUE
      IF (X .EQ. 4342 .OR. X .EQ.-1014)  KEEP = .TRUE.
   80 CONTINUE
      IF (KEEP) GO TO 90
      IF  (NN .LT. NOB) GO TO 15
      GO TO 165
   90 MM=MM+1
      MS=MM+1
      CALL BLKOUT(NWDREC,JDAT,MS,NOTFI,ISTAT)
      IF (MOD(MM,50) .EQ. 1) WRITE(6,2010) INFILE,OUTFIL
      WRITE (6,2020) (JDAT(LJM),LJM=1,22)
  160 CONTINUE
      IF (NN .LT. NOB) GO TO 15
  165 CONTINUE
      DO 170 I=2,44
  170 JDAT(I)=-32768
      JDAT(1)=MM
      CALL BLKOUT(NWDREC,JDAT,01,NOTFI,ISTAT)
      WRITE (6,2030) INFILE,OUTFIL,MM
      STOP 0000
 1000 FORMAT(I10,10X,2A6,8X,2A6)
 2000 FORMAT(10X,'INPUT FILE NAME IS ',2A6//
     *10X,'NO. OF INTERPRETED OBS/REP IN THE INPUT FILE =',I6//
     *10X,'OUTPUT FILE NAME IS ',2A6//
```

```
     *10X,'STATION DENSITY IN OUTPUT FILE =',F5.3)
2010 FORMAT('1',10X,'LIST OF INTERPRETED OBS/REP SENT FROM ',2A6,' TO '
     *,2A6  /'       IX      IY      IZ  ITIME IOBC ITYPE IVALU NTCLC   NCEIL
     * NVV  MINBAS MAXTOP MSPWE  LAY1 LAY2 LAY3 LAY4 LAY5 LAY6 LAY7 LAY8
     * LAY9')
2020 FORMAT(3X,I5,1X,I5,1X,I5,2X,I4,1X,I4,2X,I3,3X,I2,2X,6(I6,1X),1X,9(
     *I4,1X))
2030 FORMAT(/10X,' TOTAL NUMBER OF INTERPRETED OBS/REP SENT FROM FILE '
     *,2A6,' TO FILE ',2A6,' WAS ',I5)
      END
```

```
CEAS*CEASS(1).CEMAIN/IJFL
      C     READS IN INTERPRETED OBS FROM A FILE, PRINTS OUT AND STORES THEM
      C             VIA STOREC.

            INTEGER TASK
            COMMON /CLOCKT/NOWTYM,LASTSK
            DIMENSION JDAT(44),F1(4),F2(7),I1(12)
            DATA NOBWRT/22/, KFIN0/5/, KFIN2/7/, NWDREC/44/

            JOBCT=0

            LAST=0
            NPRT=0
            LASTSK = 0
          5 READ  (5,1000) TASK,NPRT,NOWTYM
       1000 FORMAT(8I10)
            WRITE (6,2000) TASK,NPRT,NOWTYM
       2000 FORMAT('1',5X,'TASK=',I4,5X,'NPRT=',I4,5X,'NOWTYM=',I5)
            GO TO (160,10,200,200),TASK
         10 CALL BLKIN(NWDREC,JDAT,1,KFIN2,ISTAT)
            NOB=JDAT(1)
            NEND=NOB+1
            DO 30 NN=2,NEND
            CALL BLKIN(NWDREC,JDAT,NN,KFIN2,ISTAT)
            IF (NN .GT. 2) GO TO 20
            IF (LASTSK .EQ. 0 .AND. TASK .EQ. 2) LASTSK=3
         20 CALL EXEC1(TASK,TIME,JDAT,F1,LAST,TYMOLD,F2,I1,JOBCT)
            LASTSK=2
         30 CONTINUE
            LASTSK=TASK
        140 TASK=5
            IF (SENSE SWITCH 1) 150,160
        150 CONTINUE
            WRITE (6,3000) JOBCT
       3000 FORMAT('1',10X,'NUMBER OF INTERPRETED OBS/REPS INPUT =',I4,
           *      /'      IX     IY     IZ  ITIME IOBC ITYPE IVALU NTCLC  NCEIL
           * NVV  MINBAS MAXTOP MSPWE  LAY1 LAY2 LAY3 LAY4 LAY5 LAY6 LAY7 LAY8
           * LAY9')
            DO 155 JMO=1,JOBCT
            IF (MOD(JMO,50) .EQ. 0) WRITE (6,3000) JOBCT
            CALL BLKIN(NOBWRT,JDAT,JMO,KFIN0,ISTAT)
```

```
      155 WRITE (6,3010) (JDAT(LJM),LJM=1,22)
     3010 FORMAT(3X,I5,1X,I5,1X,I5,2X,I4,1X,I4,2X,I7,3X,I2,2X,6(I6,1X),1X,9(
         *I4,1X))
      160 CONTINUE
          CALL EXEC1(TASK,TIME,JDAT,F1,LAST,TYMOLD,F2,I1,JOBCT)
          LASTSK=TASK
          GO TO 5
      200 CONTINUE
          STOP GOOD
          END
CFAS*CFASS(1).EXEC1/IJFL
          SUBROUTINE EXEC1(TASK,TIME,OBSRPT,F1,LAST,TYMOLD,F2,I1,NOBR)
C
C         INPUT DATA (FORMAL PARAMETERS)

C         TASK = TASK REQUESTED BY FRAMS
C                 1 = SET UP THE OBS/REP STORAGE FILES
C                 2 = INPUT OBS/REP
C                 3 = CREATE A NEW CFDB
C                 4 = UPDATE THE LATEST CFDB ON FILE
C                 5 = OUTPUT UPDATED COMMON BLOCK BASE TO MASS STORAGE
C         TIME = REFERENCE TIME OF CFDB CREATION OR UPDATE
C         OBSRPT = OBS/REP
C         LAST = SEQUENCE NUMBER OF THE LAST OBS/REP STORED.
C         TYMOLD = TIME OF OLDEST OBS/REP TO BE USED IN A CREATION OR UPDATE

C         DATA STATEMENTS
C
C         LSFILE = LOGICAL DEVICE NO. OF TEMPORARY STORAGE FILE USED IN
C                 'COMOBR'.
C         NOBR = MAXIMUM NUMBER OF OBS/REP THAT CAN BE USED IN A CREATION
C                 OR UPDATE.

C         OBS/REP INPUT ELEMENTS

C         IX = X DISTANCE OF OBS/REP SITE FROM IXREF, HECTOMETERS.
C         IY = Y DISTANCE OF OBS/REP SITE FROM IYREF, HECTOMETERS.
C         IZ = OBS/REP SITE ELEVATION ABOVE MEAN SEA LEVEL, METERS.
C         ITIME = TIME OF OBS/REP (0-1440)
C         ITYPE = TYPE OF OBS/REP
```

```
C                    1 = AIRWAYS, -1 IF A SPECIAL.
C                    2 = METAR, -2 IF A SPECIAL (SPECI)
C                    3 = SYNOP
C                    4 = UPPER AIR (RAOB), -4 IF A SPECIAL
C                    5 = AFGWC 3D-NEPH OUTPUT
C     FOR EXPLANATION OF REMAINING OBS/REP INPUT ELEMENTS CONSULT
C     LISTINGS OF SUBROUTINE SFDINT IF A SURFACE OBS/REP OR
C     SUBROUTINE UADINT IF AN UPPER AIR OBS/REP.

C     CFDB PARAMETERS DETERMINED FROM OBS/REP.

C     IOBS = SEQUENCE NO. OF OBS/REP.
C     IVALU = CFDB INFORMATION VALUE OF THE OBS/REP
C     NTCLC = TOTAL CLOUD COVER, (00 TO 100)
C     NCEIL = HEIGHT OF CEILING LAYER (AGL), DEKAMETERS. MINUS IF A
C              VARIABLE CEILING. LAST DIGIT OF NCEIL INDICATES THE
C              METHOD BY WHICH THE CEILING WAS DETERMINED.
C                    1 = MEASURED
C                    2 = AIRCRAFT
C                    3 = BALLOON
C                    4 = RADAR
C                    5 = ESTIMATED
C                    6 = INDEFINITE
C     NVV = PREVAILING SURFACE VISIBILITY, METERS. MINUS IF VARIABLE.
C     MINBAS = HEIGHT OF BASE OF LOWEST CLOUD, DEKAMETERS.
C     MAXTOP = HEIGHT OF TOP OF HIGHEST CLOUD THAT COULD BE DETERMINED
C              FROM OBS/REP ELEMENTS, DEKAMETERS.
C     MSPWE = MOST SIGNIFICANT PRESENT WEATHER ELEMENT. (WMO CODE 4577)
C     LCOV(I) = PERCENT CLOUD COVER IN THE CFDB LAYERS, (00 TO 100).
C                              CFDB LAYERS
C                    LAYER          BOTTOM                    TOP
C                      1         0 FEET      0 METERS    150 FEET     45 METERS
C                      2       150          45           300          91
C                      3       300          91           600         183
C                      4       600         183          1000         305
C                      5      1000         305          2000         610
C                      6      2000         610          3500        1067
C                      7      3500        1067          5000        1524
C                      8      5000        1524          6500        1981
C                      9      6500        1981         10000        3048

```

```
      INTEGER TASK,TIME,OBSRPT,TYMOLD

      COMMON /CLOCKT/NOWTYM,LASTSK
      COMMON /OBSREP/IX,IY,IZ,ITIME,IOBC,ITYPE,IVALU,NICLC,NCEIL,NVV,
     *MINBAS,MAXTOP,MSPWE,LCOV(9),ICL,ITSC,ICM,TCH,ICTS(10),NWEA(7),IPW,
     *NOUSE(99)
      DIMENSION OBSRPT(143),KOBR(143),F1(4),F2(7),I1(17)
      INCLUDE BASE,LIST

      EQUIVALENCE (KOBR(1),IX)

      DATA LSFILE/3/,NOBR/100/
      DATA KNUMBR /0/
      DATA IPRT/6/
      DATA NOBWRT/22/,KFINO/5/
      DATA MISS/-32768/

      GO TO (2,2,70,70,125),TASK
    2 IF (LASTSK .LE. 2) GO TO 5
C
C     RETRIEVE THE CONTENTS OF COMMON /BASE/ FROM MASS STORAGE.

      CALL BLKIN(KWORDS,BXSECT,1,KNUMBR,KSTATI)
      WRITE (6,7000) NINI,IBLOCK,NBJNOW,INUMBR,ISTATI,ISTATO,JNUMBR,JSTA
     *TI,JSTATO,JTIME,LASTJ

    5 CONTINUE
      GO TO (10,20,70,70),TASK
C
C     COME HERE TO INITIALIZE AND SET UP OBS/REP STORAGE FILES
C
   10 CALL BEGIN
      IOBC=0
      RETURN
   20 IOBC=LAST + 1
      NOB=NOB+1
      IF (SENSE SWITCH 1) 67,68
   67 CALL BLKOUT(NOBWRT,OBSRPT,NOB,KFINO,ISTAT)
   68 CONTINUE
      CALL STOREC(OBSRPT)
```

```
      LAST=IOBC
      IF(LAST .EQ. NOBP) LAST=0
   70 RETURN
C     STORE THE CONTENTS OF COMMON /BASE/ ON MASS STORAGE.

  125 CALL BLKOUT(KWORDS,DXSECT,I,KNUMBR,KSTATI)
      WRITE (6,3010) NINI,IBLOCK,NBJNOW,INUM  ,ISTATI,ISTATO,JNUMBR,JSTA
     *TI,JSTATO,JTIME,LASTJ

  130 RETURN
 3000 FORMAT(' CONTENTS OF COMMON /BASE/ HAS BEEN READ IN FROM MASS STOR
     *AGE- '/' NINI =',I7/' IBLOCK =',I7/' NBJNOW=',I7/' INUMBR =',I7/'
     *ISTATI =',I7/' ISTATO =',I7/' JNUMBR =',I7/' JSTATI =',I7/' JSTATO
     * =',I7/' JTIME =',I7/' LASTJ =',I7////)
 3010 FORMAT(' CONTENTS OF COMMON /BASE/ HAS BEEN OUTPUT TO MASS STORAGE
     *-'/' NINI =',I7/' IBLOCK =',I7/' NBJNOW =',I7/' INUMBR =',I7/' IST
     *ATI =',I7/' ISTATO =',I7/' JNUMBR =',I7/' JSTATI =',I7/' JSTATO ='
     *,I7/' JTIME =',I7/' LASTJ =',I7////)
      END
```

```
CFAS*CFASS(1).CFMAIN/TSK3RI
C       CFMAIN
C       TEST DRIVER FOR THE CFAS
        INTEGER TASK,TIME,TYMOLD,CFASD,GROPV,GRD
        COMMON /IDAT/ JX,JY,JZ,ITIME,IOBC,ITYPE,IVALU,NTCLC,NCEIL,NVV,
       *MINBAS,MAXTOP,MCPWF,LCOV(9),ICL,ITSC,TCM,ICH,ICTS(10),NWEA(7),IPW,
       *IWD,IWS,IPFP,ITT,ITD,TVIS,NH,IH,NS(10),IHS(10),ITHN(10),ICLG,TCLGV
       *,IVISC,NOUSE(58)
        COMMON /CLOCKI/NOWTYM,LASTSK
        COMMON /MAP/ XREF,YREF,CMRD
        COMMON /OUTPT/IBEG,IEND,JBEG,JEND


        DIMENSION IDAT(143),JDAT(143),IZ(30),IP(30),IT(30),IDD(30),DIST(3)
       *,TYMC(3),ISSQ(5),CFASD(6010),GROPV(20,20,15),IDENT(10),Z(30),P(30)
       *,T(30),DD(30)
        EQUIVALENCE (IDAT(1),JX),(IDAT(23),ICL,IZ(1)),(IDAT(53),NS(1),IP(1
       *)),(IDAT(83),ICLG,IT(1)),(IDAT(113),IDD(1)),(IDAT(143),NRRL),
       *(CFASD(11),GROPV(1,1,1)),(CFASD(1),IDENT(1))
        DATA MISS/-32768/
        DATA NCFF/4/
        DATA GRD/25/,LNTHX/500/,LNTHY/500/
        DATA XZRO/164.66/,YZRO/3399.56/,CNTMER/85.5/
        DATA NOSWRT/22/,KFINC/5/

        LAST=0
        NPRT=0
        LASTSK = 0
        XREF=XZRO
        YREF=YZRO
        CMRD=CNTMER
        IGP=LNTHX/GRD
        JGP=LNTHY/GRD
        ICFDB=IGP*JGP*15+10
      5 READ  (5,1000) TASK,NPRT,NOWTYM
   1000 FORMAT(8I10)
        WRITE (6,2000) TASK,NPRT,NOWTYM
        MFG=1
   2000 FORMAT('1',5X,'TASK=',I4,5X,'NPRT=',I4,5X,'NOWTYM=',I5)
        GO TO (130,10,200,200),TASK
     10 DO 20 I=1,143
```

```
   20 IDAT(I)=MISS
      READ (5,1000,END=140) JX,JY,JZ,ITIME,ITYPE,IVIS,NC
      MFG=IABS(ITYPE/10)
      ITYPE=MOD(ITYPE,10)
      MI=IABS(ITYPE)
      GO TO (30,70,30,80,100),MI
   30 IF(NPRT .EQ. 0) GO TO 33
      WRITE (6,2005)
 2005 FORMAT(/)
      WRITE (6,2010)JX,JY,JZ,ITIME,ITYPE,IVIS,NC
 2010 FORMAT(4X,'JX',8X,'JY',8X,'JZ',6X,'ITIME',5X,'ITYPE',6X,'IVIS',6X,
     *'NC'/7(2X,I6,2X)/)
   33 GO TO (35,50,40,80,100),MI
   35 READ (5,1000) ICLG,ICLGV,IVISC
      IF(NPRT .EQ. 0) GO TO 50
      WRITE(6,2020) ICLG,ICLGV,IVISC
 2020 FORMAT(3X,'ICLG',5X,'ICLGV',5X,'IVISC'/3(2X,I6,2X)/)
      GO TO 50
   40 READ (5,1000) ITSC,NH,ICL,IH,ICM,ICH,IPW
      IF(NPRT .EQ. 0) GO TO 50
      WRITE(6,2030) ITSC,NH,ICL,IH,ICM,ICH,IPW
 2030 FORMAT(3X,'ITSC',7X,'NH',7X,'ICL',8X,'IH',7X,'ICM',7X,'ICH',7X,'IP
     *W'/7(2X,I5,2X)/)
   50 READ (5,1000) (NWEA(I),I=1,7)
      IF(NPRT .EQ. 0) GO TO 55
      WRITE (6,2035) (NWEA(I),I=1,7)
 2035 FORMAT(2X,'NWEA(1)',3X,'NWEA(2)',3X,'NWEA(3)',3X,'NWEA(4)',3X,'NWE
     *A(5)',3X,'NWEA(6)',3X,'NWEA(7)'/7(3X,I4,3X)/)
   55 IF(NC .EQ. 0) GO TO 110
      READ  (5,1010) (NS(I),ICTS(I),IHS(I),ITHN(I),I=1,NC)
 1010 FORMAT(4I10)
      IF(NPRT .EQ. 0) GO TO 110
      WRITE(6,2040)
 2040 FORMAT(4X,'NS',8X,'ICTS',8X,'IHS',9X,'ITHN'/)
      WRITE(6,2050)(NS(I),ICTS(I),IHS(I),ITHN(I),I=1,NC)
 2050 FORMAT(4(2X,I6,4X))
      GO TO 110
   80 IF(NPRT .EQ. 0) GO TO 85
      WRITE (6,2005)
      WRITE(6,2060) JX,JY,JZ,ITIME,ITYPE
 2060 FORMAT(4X,'JX',8X,'JY',8X,'JZ',6X,'ITIME',5X,'ITYPE'/5(2X,I6,2X)/)
```

```
   85 I=0
   90 I=I+1
      READ  (5,1000) IZ(I),IP(I),IT(I),IDD(I)
      Z(I)=FLOAT(IZ(I))
      IT(I)=IT(I)+2732
      P(I)=FLOAT(IP(I))*.1
      P(I)=ABS(P(I))
      T(I)=FLOAT(IT(I))*.1
      DD(I)=FLOAT(IDD(I))*.1
      IF((IP(I) .GE. 0) .OR. (IP(I) .EQ. MISS)) GO TO 90
      NRRL=I
      IF(NPRT .EQ. 0) GO TO 110
      WRITE (6,2070)
 2070 FORMAT(9X,'IZ',10X,'IP',10X,'IT',10X,'IDD',10X,'Z',12X,'P',11X,'T'
     *11X,'DD'/)
      WRITE(6,2080) (IZ(I),IP(I),IT(I),IDD(I),Z(I),P(I),T(I),DD(I),I=1,
     *NRRL)
 2080 FORMAT(3X,4I12,4F12.2)
      GO TO 110
  100 IF(NPRT .EQ. 0) GO TO 105
      WRITE (6,2005)
      WRITE (6,2060) JX,JY,JZ,ITIME,ITYPE
  105 READ  (5,1000) NICLD,NCEIL,NVV,MINBAS,MAXTOP,MSPWF,(LCOV(I),I=1,9)
      IF(NPRT .EQ. 0) GO TO 110
      WRITE (6,2090) NICLD,NCEIL,NVV,MINBAS,MAXTOP,MSPWF,(LCOV(I),I=1,9)
 2090 FORMAT(3X,'NICLD',5X,'NCEIL',6X,'NVV',5X,'MINBAS',4X,'MAXTOP',4X,'
     *MSPWF',4X,'LCOV(1)',3X,'LCOV(2)'/8(3X,I6,2X)//2X,'LCOV(3)',3X,'LCO
     *V(4)',3X,'LCOV(5)',3X,'LCOV(6)',3X,'LCOV(7)',3X,'LCOV(8)',3X,'LCOV
     *(9)'/7(2X,I6,2X)///)
  110 DO 120 J=1,143
  120 JDAT(J)=IDAT(J)
      IF (LASTSK .EQ. 0 .AND. TASK .EQ. 2) LASTSK=3
  130 CALL CFEXEC(TASK,TIME,JDAT,X0,Y0,XLN,YLN,LAST,TYMOLD,DSP,DIST,TYMC
     *,ICCG,NCCG,NBKOUT,IDENT)
      LASTSK=TASK
      IF (MFG .LE. 0) GO TO 10
  140 TASK=5
      IF (LASTSK .EQ. 1) GO TO 150
      IF (SENSE SWITCH 1) 150,150
  150 WRITE (6,3000) LAST
 3000 FORMAT('1',10X,'NUMBER OF OBSERVATIONS INTERPRETED =',I4,
```

```
     •      /'      IX      IX      I7  ITIME IOBC ITYPE IVALU NTOLC   NCOIL
     • NVV   MINTAC MAXTOP MOFWF  LAY1 LAY2 LAY3 LAY4 LAY5 LAY6 LAY7 LAY8
     • LAY9')
      DO 155 JMO=1,LAST
      IF (MOD(JMO,50) .EQ. 0) WRITE (6,3000)
      CALL ELKIN(NOBWRT,JDAT,JMO,KFINO,ISTAT)
  155 WRITE (6,3010) (JDAT(LJM),LJM=1,22)
 3010 FORMAT(3X,I5,1X,I5,1X,I5,2X,I4,1X,I4,2X,I3,3X,I2,2X,6(I6,1X),1X,9(
     •I4,1X))
  160 CONTINUE
      CALL CREXEC(TASK,TIME,JDAT,XO,YO,XLN,YLN,LAST,TYMOLD,DSP,DIST,TYMC
     •,ISSQ,NSSQ,NBKOUT,IDENT)
      GO TO 5
  200 READ (5,1000) NBKOUT @ INPUT LAST RECORD NUMBER ON CRDB
      WRITE (6,2049) NBKOUT
 2049 FORMAT (1X,'NBKOUT = ',I5)
      READ (5,1000) TIME,TYMOLD,NSSQ,(ISSQ(I),I=1,NSSQ)
      WRITE (6,2100) TIME,TYMOLD,NSSQ,(ISSQ(I),I=1,NSSQ)
 2100 FORMAT(/3X,'TIME',5X,'TYMOLD',5X,'NSSQ',4X,'ISSQ(1)',3X,'ISSQ(2)',
     •3X,'ISSQ(3)',3X,'ISSQ(4)'/8(2X,I6,2X)/)
      READ  (5,1020) DSP,(DIST(I),I=1,3),(TYMC(I),I=1,3)
 1020 FORMAT(8F10.1)
      WRITE (6,2110) DSP,(DIST(I),I=1,3),(TYMC(I),I=1,3)
 2110 FORMAT(/6X,'DSP',6X,'DIST(1)',5X,'DIST(2)',5X,'DIST(3)',5X,'TYMC(1
     •)',5X,'TYMC(2)',5X,'TYMC(3)'/7(2X,F8.1,2X)/)
      IF(TASK .EQ. 3) GO TO 250
      READ  (5,1030) XO,YO,XLN,YLN
      WRITE (6,2120) XO,YO,XLN,YLN
 2120 FORMAT(/5X,'XO',10X,'YO',9X,'XLN',9X,'YLN'/4(2X,F8.1,2X))
  250 NBKOUT=NBKOUT+1
      IF (LASTSK .EQ. 0) LASTSK = 3
      READ(5,2180) IDENT
 2180 FORMAT(10A6)
      CALL CREXEC(TASK,TIME,JDAT,XO,YO,XLN,YLN,LAST,TYMOLD,DSP,DIST,TYMC
     •,ISSQ,NSSQ,NBKOUT,IDENT)
      STOP 2000
      END
OTAP•CRATE(1).EXEC1/TSK3RI
      SUBROUTINE EXEC1(TASK,TIME,ORSPRT,F1,LAST,TYMOLD,F2,IN,NOR)
      INTEGER TASK,TIME,ORSPRT,TYMOLD
```

```
      COMMON /CLOCKT/NOWTYM,LASTSK
      COMMON /OBSREP/IX,IY,IZ,ITIME,IOBC,ITYPE,IVALU,NCLC,NCEIL,NVV,
     *MINBAS,MAXTOP,MSPWE,LCOV(9),ICL,ITSC,TCM,TCH,ICTS(10),NWEA(7),IPW,
     *NOUSE(99)
      DIMENSION INOBEL(44),F1(4),F2(7),I1(7)
      INCLUDE BASE,LIST


      DATA LTFILE/3/,NOBR/100/
      DATA KNUMBR /0/
      DATA IPRT/6/
      DATA NOBWRT/22/,KFINC/5/
      DATA MISS/-32768/

      GO TO (2,2,70,70,135),TASK
    2 IF (LASTSK .LE. 2) GO TO 5

C     RETRIEVE THE CONTENTS OF COMMON /BASE/ FROM MASS STORAGE.

      CALL BLKIN(KWORDS,DXSECT,1,KNUMBR,KSTATI)
      WRITE (6,3000) NINI,IBLOCK,NBJNOW,INUMBR,ISTATI,ISTATO,JNUMBR,JSTA
     *TI,JSTATO,JTIME,LASTJ

    5 CONTINUE
      GO TO (10,20,70,70),TASK
   10 RETURN
   20 RETURN
   70 NOBS=0
      IF(LASTSK .LE. 2) GO TO 80

C     RETRIEVE THE CONTENTS OF COMMON /BASE/ FROM MASS STORAGE.

      CALL BLKIN(KWORDS,DXSECT,1,KNUMBR,KSTATI)
      WRITE (6,3000) NINI,IBLOCK,NBJNOW,INUMBR,ISTATI,ISTATO,JNUMBR,JSTA
     *TI,JSTATO,JTIME,LASTJ

   80 INCODE=1
C
C     INSURE THAT TYMOLD IS NOT MORE THAN 1080 MINUTES (18 HOURS) PRIOR
C         TO TIME. RESET TYMOLD TO TIME-1080 IF NECESSARY.
C
```

```
      IDIF=IIYMDF(TIME,TYMOLD)
      IF(IDIF .GT. 0) GO TO 90

C     RETURN IF TYMOLD IS MORE THAN 24 HOURS PRIOR TO TIME

      WRITE(IPRT,1990) TYMOLD, TIME
 1990 FORMAT(' TYMOLD,',I5,' IS EITHER MORE THAN 24 HOURS PRIOR TO TIME,
     *',I5,' OR IS MORE RECENT THAN TIME.'/' TASK CANNOT BE COMPLETED WI
     *TH THIS AMBIGUITY.'//)
   90 IF(IDIF .LE. 1080) GO TO 100
      TYMOLD=TIME-1080
      IF(TYMOLD .LT. 0) TYMOLD=1440+TYMOLD
C
      WRITE(IPRT,2000) IDIF,TYMOLD
 2000 FORMAT(' TIME DIFFERENCE BETWEEN REFERENCE TIME AND TIME OF OLDEST
     * USEABLE OBS/REP = ',I3,' MINUTES'/' TIME OF OLDEST USEABLE OBS/RE
     *P RESET TO ',I4,' MINUTES WHICH IS 1080 MINUTES PRIOR TO REFERENCE
     *TIME'//)
C
C     RETREIVE OBS/REP IN REVERSE CHRONOLOGICAL ORDER FROM TIME TO
C         TYMOLD
C
  100 CALL RETOBR(INCODE,TIME,INOBEL,NOMORE,TYMOLD)
      INCODE=2
      IF (INOBEL(9) .EQ. 32000) INOBEL(9)=MISS
C
C     JUMP TO 120 IF THERE ARE NO MORE OBS/REP IN THE DATA BASE.
C
      IF(NOMORE .EQ. 1) GO TO 120
      NOB=NOB+1
      CALL BLKOUT(23,INOBEL,NOB,LIFILE,ISTAT)
C
C     JUMP BACK TO 100 AND ATTEMPT TO RETRIEVE ANOTHER OBS/REP IF THE
C     MAXIMUM USEABLE NUMBER HAS NOT BEEN REACHED.
C
      IF(NOB .LT. NOBR) GO TO 100
  120 CONTINUE
      IF(LASTSK .GE. 7) GO TO 130

C     STORE THE CONTENTS OF COMMON /BASE/ ON MASS STORAGE.
```

```
  125 CALL BLKOUT(KWORDS,DXSECT,1,KNUMBR,KSTATI)
      WRITE (6,3010) NINI,IBLOCK,NBJNOW,INUMBR,ISTATI,ISTATO,JNUMBR,JSTA
     *TI,JSTATO,JTIME,LASTJ

  130 RETURN
 3000 FORMAT(' CONTENTS OF COMMON /BASE/ HAS BEEN READ IN FROM MASS STOR
     *AGE- '/' NINI =',I7/' IBLOCK =',I7/' NBJNOW =',I7/' INUMBR =',I7/'
     *ISTATI =',I7/' ISTATO =',I7/' JNUMBR =',I7/' JSTATI =',I7/' JSTATO
     * =',I7/' JTIME =',I7/' LASTJ =',I7////)
 3010 FORMAT(' CONTENTS OF COMMON /BASE/ HAS BEEN OUTPUT TO MASS STORAGE
     *-'/' NINI =',I7/' IBLOCK =',I7/' NBJNOW =',I7/' INUMBR =',I7/' IST
     *ATI =',I7/' ISTATO =',I7/' JNUMBR =',I7/' JSTATI =',I7/' JSTATO ='
     *,I7/' JTIME =',I7/' LASTJ =',I7////)
      END
CFAS*CFASS(1).EXEC2/TSK3RI
      SUBROUTINE EXEC2(TASK,TIME,OBSRPT,XO,YO,XLN,YLN,LAST,TYMOLD,DSP,
     *DIST,TYMC,ISSQ,NSSQ,NBKOUT,IDENT,NOB)
      DIMENSION INOBS(23,100)
      DATA LSFILE/3/
      DO 70 I=1,NOB
   70  CALL BLKIN(23,INOBS(1,I),I,LSFILE,ISTAT)
      WRITE (6,3000) NOB
      DO 90 I=1,NOB
      IF (MOD(I,50) .EQ. 0) WRITE (6,3000) NOB
      WRITE (6,3010) (INOBS(J,I),J=1,22)
   90 CONTINUE
      RETURN
 3000 FORMAT('1',10X,'NUMBER OF OBSERVATIONS RETRIEVED FOR ANALYSIS =',
     * I4,  /'      IX     IY     IZ  ITIME IOBC ITYPE IVALU NTCLC  NCEIL
     * NVV  MINBAS MAXTOP MSPWE  LAY1 LAY2 LAY3 LAY4 LAY5 LAY6 LAY7 LAY8
     * LAY9')
 3010 FORMAT(3X,I5,1X,I5,1X,I5,2X,I4,1X,I4,3X,I3,3X,I2,2X,6(I6,1X),1X,9(
     *I4,1X))
      END
```

```
CFAS*CFASS(1).CFSTAT
      INTEGER WORDS,UNIT,FIRST,LAST,STATUS,BLOCK,HOLD,TRUTH,ANYLZD,HOLD1
     *,BKNOGT
      DIMENSION TRUTH(20,20,15),ANYLZD(20,20,15),HOLD(6010),HOLD1(6010)
      EQUIVALENCE (HOLD(11),TRUTH(1,1,1)),(HOLD1(11),ANYLZD(1,1,1))

C       ** THIS PROGRAM TAKES DATA IN BLOCKS AND DOES STATISTICAL
C       ** ANALYSIS FOR THE SKY COVER, CEILING, VISIBILITY AND
C       ** PRESENT WEATHER.
C       ** WORDS = THE NUMBER OF WORDS PER BLOCK
C       ** TRUTH = THE GROUND TRUTH DATA SET
C       ** ANYLZD = THE CURRENT DATA SET MEASURED AGAINST TRUTH
C       ** BKNOGT = BLOCK NO. OF GROUND TRUTH DATA SET.

      WORDS = 6010
      UNIT = 14
      BKNOGT = 1

      WRITE (6,10)
   10 FORMAT (1X,'WHAT IS THE FIRST AND LAST BLOCK YOU WANT ANALYZED')
      READ (5,20) FIRST,LAST
      WRITE (6,20) FIRST,LAST
   20 FORMAT (2I3)

      CALL BLKIN (WORDS,HOLD,BKNOGT,UNIT,STATUS)
      DO 30 BLOCK = FIRST,LAST
         PRINT 40,BLOCK
         CALL BLKIN (WORDS,HOLD1,BLOCK,UNIT,STATUS)
         CALL COVER (TRUTH,ANYLZD)
         CALL CEILNG (TRUTH,ANYLZD)
         CALL VISIBL (TRUTH,ANYLZD)
         CALL WEATHR (TRUTH,ANYLZD)
         CALL LAYERS (TRUTH,ANYLZD)
   30 CONTINUE
   40 FORMAT ('1','STATPACK OUTPUT FOR BLOCK ',I2)
      STOP NORMAL
      END
```

```
CFAS*CFASS(1).CEILNG
          SUBROUTINE CEILNG (TRUTH,ANYLZD)
          INTEGER CELING,DATNUM,TRUTH,ANYLZD,MISSNG
          REAL DATA,NBRMIS
          DIMENSION TRUTH(20,20,15),ANYLZD(20,20,15),DATA(400,2)

          MISSNG = -32768
          DATNUM = 0
          NBRMIS = 0.
          CELING = 2

          DO 20 I = 1,20
             DO 15 J = 1,20
                IF (ANYLZD(I,J,CELING) .EQ. MISSNG) GOTO 10
                DATNUM = DATNUM + 1
                DATA(DATNUM,1) = FLOAT(TRUTH(I,J,CELING))
                DATA(DATNUM,2) = FLOAT(ANYLZD(I,J,CELING))
                GOTO 15

       10       NBRMIS = NBRMIS + 1.
       15    CONTINUE
       20 CONTINUE

          PRINT 30,NBRMIS,DATNUM
       30 FORMAT (1X,'OUT OF A POSSIBLE 400 VALUES',F4,' WERE MISSING AND',
         +         I4,' WERE VALID CEILINGS')
          CALL STATPK (DATA,DATNUM)
          RETURN
          END
```

```
CFAS*CFASS(0).COVER
      SUBROUTINE COVER (TRUTH,ANYLZD)
      INTEGER SKYCOV,DATNUM,TRUTH,ANYLZD,MISSNG
      REAL DATA,NBRMIS
      DIMENSION TRUTH(20,20,15),ANYLZD(20,20,15),DATA(400,2)

      MISSNG = -32768
      DATNUM = 0
      NBRMIS = 0.
      SKYCOV = 1

      DO 20 I = 1,20
         DO 15 J = 1,20
            IF (ANYLZD(I,J,SKYCOV) .EQ. MISSNG) GOTO 10
            DATNUM = DATNUM + 1
            DATA(DATNUM,1) = FLOAT(TRUTH(I,J,SKYCOV))
            DATA(DATNUM,2) = FLOAT(ANYLZD(I,J,SKYCOV))
            GOTO 15

   10       NBRMIS = NBRMIS + 1.
   15    CONTINUE
   20 CONTINUE

      PRINT 30,NBRMIS,DATNUM
   30 FORMAT (1X,'OUT OF A POSSIBLE 400 VALUES',F4,' WERE MISSING AND',
     +        I4,' WERE VALID SKY COVERS')
      CALL STATPK (DATA,DATNUM)
      RETURN
      END
```

CFAS•CFASS(0).LAYERS

```
      SUBROUTINE LAYERS (TRUTH,ANYLZD)
      INTEGER LAYER,DATNUM,TRUTH,ANYLZD,MISSNG,NBRMIS
      REAL DATA
      DIMENSION TRUTH(20,20,15),ANYLZD(20,20,15),DATA(400,2)

      MISSNG = -32768

      DO 40 LAYER = 7,15
         DATNUM = 0
         NBRMIS = 0
         DO 30 I = 1,20
            DO 20 J = 1,20
               IF (ANYLZD(I,J,LAYER) .EQ. MISSNG) GOTO 10
               DATNUM = DATNUM + 1
               DATA(DATNUM,1) = FLOAT(TRUTH(I,J,LAYER))
               DATA(DATNUM,2) = FLOAT(ANYLZD(I,J,LAYER))
               GOTO 20

10             NBRMIS = NBRMIS + 1
20          CONTINUE
30       CONTINUE
         L = LAYER-6
         PRINT 50,NBRMIS,DATNUM,L
         CALL STATPK (DATA,DATNUM)
40 CONTINUE
50 FORMAT (1X,'OUT OF A POSSIBLE 400 VALUES',I4,' WERE MISSING AND',
  +        I4,' WERE VALID LAYERS FOR LAYER',I3)
      RETURN
      END
```

```
CFAS*CLASS(0).STATPK
      SUBROUTINE STATPK (DATA,END)
      INTEGER END,I
      REAL SUMX,SUMY,XVAR,YVAR,COV,ERR2RD,MEANX,MEANY,XVARI,YVARI,
     +     COVARI,CORREL,RTMEAN,DATA,DATNUM
      DIMENSION DATA(400,2)

      SUMX = 0.
      SUMY = 0.
      XVAR = 0.
      YVAR = 0.
      COV = 0.
      ERR2RD = 0.
      DATNUM = FLOAT(END)

      DO 10 I = 1,END
         SUMX = SUMX + DATA(I,1)
         SUMY = SUMY + DATA(I,2)
   10 CONTINUE

      MEANX = SUMX/DATNUM
      MEANY = SUMY/DATNUM

      DO 20 I = 1,END
         XVAR = XVAR + (DATA(I,1)-MEANX)**2.
         YVAR = YVAR + (DATA(I,2)-MEANY)**2.
         COV = COV+((DATA(I,1)-MEANX)*(DATA(I,2)-MEANY))
         ERR2RD = ERR2RD+(DATA(I,1)-DATA(I,2))**2.
   20 CONTINUE

      XVARI = XVAR/(DATNUM-1)
      YVARI = YVAR/(DATNUM-1)
      COVARI = COV/(DATNUM-1)
      CORREL = COVARI/(SQRT(XVARI)*SQRT(YVARI))
      RTMEAN = SQRT(ERR2RD/DATNUM)

      PRINT 30,MEANX,MEANY,XVARI,YVARI,COVARI,CORREL,RTMEAN
   30 FORMAT (8X,'GROUND TRUTH    ANALYZED',//,
     +        1X,'MEAN',5X,F10.4,1X,F10.4,//,
     +        1X,'VARIANCE ',F10,1X,F10,///,
     +        1X,'COVARIANCE = ',F10.1,//,
```

```
                 +        1X,'CORRELATION COEFFICIENT = ',F10.4,//,
                 +        1X,'ROOT MEAN SQUARE ERROR = ',F10.4,/////)
                  RETURN
                  END


CFAS*CFASS(0).VISIBL
                  SUBROUTINE VISIBL (TRUTH,ANYLZD)
                  INTEGER VISIB,DATNUM,TRUTH,ANYLZD,MISSNG
                  REAL DATA,NBRMIS
                  DIMENSION TRUTH(20,20,15),ANYLZD(20,20,15),DATA(400,2)

                  MISSNG = -32768
                  DATNUM = 0
                  NBRMIS = 0.
                  VISIB = 3

                  DO 20 I = 1,20
                     DO 15 J = 1,20
                        IF (ANYLZD(I,J,VISIB) .EQ. MISSNG) GOTO 10
                        DATNUM = DATNUM + 1
                        DATA(DATNUM,1) = FLOAT(TRUTH(I,J,VISIB))
                        DATA(DATNUM,2) = FLOAT(ANYLZD(I,J,VISIB))
                        GOTO 15

               10       NBRMIS = NBRMIS + 1.
               15    CONTINUE
               20 CONTINUE

                  PRINT 30,NBRMIS,DATNUM
               30 FORMAT (1X,'OUT OF A POSSIBLE 400 VALUES',F4,' WERE MISSING AND',
                 +        I4,' WERE VALID VISIBILITYS')
                  CALL STATPK (DATA,DATNUM)
                  RETURN
                  END
```

```
CFAS*CFASS(0).WEATHR
      SUBROUTINE WEATHR (TRUTH,ANYLZD)
      INTEGER WETHER,DATNUM,TRUTH,ANYLZD,MISSNG
      REAL DATA,NBRMIS
      DIMENSION TRUTH(20,20,15),ANYLZD(20,20,15),DATA(400,2)

      MISSNG = -32768
      DATNUM = 0
      NBRMIS = 0.
      WETHER = 6

      DO 20 I = 1,20
         DO 15 J = 1,20
            IF (ANYLZD(I,J,WETHER) .EQ. MISSNG) GOTO 10
            DATNUM = DATNUM + 1
            DATA(DATNUM,1) = FLOAT(TRUTH(I,J,WETHER))
            DATA(DATNUM,2) = FLOAT(ANYLZD(I,J,WETHER))
            GOTO 15

10          NBRMIS = NBRMIS + 1.
15       CONTINUE
20    CONTINUE

      PRINT 30,NBRMIS,DATNUM
30    FORMAT (1X,'OUT OF A POSSIBLE 400 VALUES',F4,' WERE MISSING AND',
     +         I4,' WERE VALID PRESENT WEATHERS')
      CALL STATPK (DATA,DATNUM)
      RETURN
      END
```

8.2 LISTINGS OF REVISED CFAS-CFAR PROGRAM ELEMENTS

```
CFAC*CTASS(1).BASE
      BASE PROC
            COMMON /BASE/ DXSECT, DYSECT, EDGE, IBLOCK, IDTIME, IDXUTM,
           * IDYUTM, INUMBR, ISTATI, ISTATO, JNUMBR, JSTATI, JSTATO, JTIME,
           * LASTJ, MAXOPS, NBJNOW, NBLKFJ, NCOLS, NGX, NGY, NINI, NINTAB,
           * NROWS, NPRBFI, NPRBFJ, NSECTR, NWDBKI, NWDBKJ, NWDREC, NXSECT,
           * NYSECT, UTMPSD, XBASE, XMAX, XMIN, YBASE, YMAX, YMIN,
           * NNEWRS(100), NALLRS(100), ITABLE(4,200), IBUF(2200), JBUF(528),
           * JTIMES(100), IRXMAX, IRXMIN, IRYMAX, IRYMIN

            DATA KWORDS /3871/

      END
```

```
CFAC*CFACD(1).CFMAIN/CCK
C      CFMAIN
C      TEST DRIVER FOR THE CFAC
       INTEGER TASK,TIME,TYMOLD,CFACD,GROPV,GRD
       COMMON /IDAT/ JX,JY,JT,ITIME,ICRC,ITYPE,IVALU,NICLC,NCEIL,NVV,
      *MINBAS,MAXICE,MTRWE,LCOV(8),ICL,ITCC,TCM,TCH,ICIS(10),NWEA(7),IPW,
      *IWD,IWS,IPRS,III,ITD,IVIS,NH,IH,NC(10),IHC(10),ITHN(10),ICLG,ICLGV
      *,IVISC,NOUSE(58)
       COMMON /CLOCK1/NOWTYM,LASTSK
       COMMON /MAP/ XREF,YREF,CMPR
       COMMON /OUTPT/IBEG,IEND,JBEG,JEND


       DIMENSION IDAT(143),JDAT(143),IZ(30),IP(30),IT(30),IDD(30),DIST(3)
      *,TYMC(3),ISCD(5),CFACD(6010),GROPV(20,20,15),IDENT(10),Z(30),P(30)
      *,T(30),DD(30)
       EQUIVALENCE (IDAT(1),JX),(IDAT(23),ICL,IZ(1)),(IDAT(53),NC(1),IP(1
      *)),(IDAT(83),ICLG,IT(1)),(IDAT(113),IDD(1)),(IDAT(143),NPRL),
      *(CFACD(11),GROPV(1,1,1)),(CFACD(1),IDENT(1))
       DATA MISS/-32768/
       DATA NCFF/4/
       DATA GRD/25/,LNTHX/500/,LNTHY/500/
       DATA XZRO/134.55/,YZRO/3399.55/,CNTMER/35.5/
       DATA NOBWPT/22/,KEIND/5/
       DATA NSCD,ISCD/5,2,3,4,6,8/
       DATA DSP,DIST,TYMC/50.,20.,80.,100.,50.,100.,150./

       LAST=0
       NPRT=0
       LASTSK = 0
       XREF=XZRO
       YREF=YZRO
       CMPR=CNTMER
       IBEG=LNTHX/GRD
       JBEG=LNTHY/GRD
       ICFACD=IBEG*JBEG*15+10
     5 READ  (5,1000) TASK,NPRT,NOWTYM
  1000 FORMAT(3I10)
       WRITE (6,2000) TASK,NPRT,NOWTYM
       NPR=1
  2000 FORMAT('1',5X,'TASK=',I4,5X,'NPRT=',I4,5X,'NOWTYM=',I5)
```

```
      GO TO (130,10,200,200),TASK
   10 DO 20 I=1,143
   20 IDAT(I)=MISS
      READ (5,1000,END=140) JX,JY,JZ,ITIME,ITYPE,IVIS,NC
      MFC=IABS(ITYPE/10)
      ITYPE=MOD(ITYPE,10)
      MT=IABS(ITYPE)
      GO TO (30,30,30,30,100),MT
   30 IF(NPRT .EQ. 0) GO TO 33
      WRITE (6,2005)
 2005 FORMAT(/)
      WRITE (6,2010)JX,JY,JZ,ITIME,ITYPE,IVIS,NC
 2010 FORMAT(4X,'JX',8X,'JY',8X,'JZ',6X,'ITIME',5X,'ITYPE',5X,'IVIS',6X,
     *'NC'/7(2X,I6,2X)/)
   33 GO TO (35,50,40,80,100),MT
   35 READ (5,1000) ICLG,ICLGV,IVISC
      IF(NPRT .EQ. 0) GO TO 50
      WRITE(6,2020) ICLG,ICLGV,IVISC
 2020 FORMAT(3X,'ICLG',5X,'ICLGV',5X,'IVISC'/3(2X,I6,2X)/)
      GO TO 50
   40 READ (5,1000) ITSC,NH,ICL,IH,ICM,ICH,IPW
      IF(NPRT .EQ. 0) GO TO 50
      WRITE(6,2030) ITSC,NH,ICL,IH,ICM,ICH,IPW
 2030 FORMAT(3X,'ITSC',7X,'NH',7X,'ICL',8X,'IH',7X,'ICM',7X,'ICH',7X,'IP
     *W'/7(2X,I6,2X)/)
   50 READ (5,1000) (NWEA(I),I=1,7)
      IF(NPRT .EQ. 0) GO TO 55
      WRITE (6,2035) (NWEA(I),I=1,7)
 2035 FORMAT(2X,'NWEA(1)',3X,'NWEA(2)',3X,'NWEA(3)',3X,'NWEA(4)',3X,'NWE
     *A(5)',3X,'NWEA(6)',3X,'NWEA(7)'/7(3X,I4,3X)/)
   55 IF(NC .EQ. 0) GO TO 110
      READ (5,1010) (NS(I),ICTS(I),IHS(I),ITHN(I),I=1,NC)
 1010 FORMAT(4I10)
      IF(NPRT .EQ. 0) GO TO 110
      WRITE(6,2040)
 2040 FORMAT(4X,'NS',9X,'ICTS',8X,'IHS',9X,'ITHN'/)
      WRITE(6,2050)(NS(I),ICTS(I),IHS(I),ITHN(I),I=1,NC)
 2050 FORMAT(4(2X,I6,4X))
      GO TO 110
   80 IF(NPRT .EQ. 0) GO TO 85
      WRITE (6,2005)
```

```
      WRITE(6,2060) JX,JY,JZ,ITIME,ITYPE
 2060 FORMAT(4X,'JX',8X,'JY',8X,'JZ',6X,'ITIME',6X,'ITYPE'/5(2X,I6,2X)/)
   85 I=0
   90 I=I+1
      READ  (5,1000) IZ(I),IP(I),IT(I),IDD(I)
      Z(I)=FLOAT(IZ(I))
      IT(I)=IT(I)+2732
      P(I)=FLOAT(IP(I))*.1
      P(I)=ABS(P(I))
      T(I)=FLOAT(IT(I))*.1
      DD(I)=FLOAT(IDD(I))*.1
      IF((IP(I) .GE. 0) .OR. (IP(I) .EQ. MISS)) GO TO 90
      NPPL=I
      IF(NPRT .EQ. 0) GO TO 110
      WRITE (6,2070)
 2070 FORMAT(3X,'IZ',10X,'IP',10X,'IT',10X,'IDD',10X,'Z',12X,'P',11X,'T'
     *11X,'DD'/)
      WRITE(6,2080) (IZ(I),IP(I),IT(I),IDD(I),Z(I),P(I),T(I),DD(I),I=1,
     *NPPL)
 2080 FORMAT(3X,4I12,4F12.2)
      GO TO 110
  100 IF(NPRT .EQ. 0) GO TO 105
      WRITE (6,2005)
      WRITE (6,2060) JX,JY,JZ,ITIME,ITYPE
  105 READ  (5,1000) NICLC,NCEIL,NVV,MINBAS,MAXTOP,MSPWS,(LCOV(I),I=1,9)
      IF(NPRT .EQ. 0) GO TO 110
      WRITE (6,2090) NICLC,NCEIL,NVV,MINBAS,MAXTOP,MSPWS,(LCOV(I),I=1,9)
 2090 FORMAT(3X,'NICLC',5X,'NCEIL',5X,'NVV',5X,'MINBAS',4X,'MAXTOP',4X,'
     *MSPWS',4X,'LCOV(1)',3X,'LCOV(2)'/8(2X,I6,2X)//2X,'LCOV(3)',3X,'LCO
     *V(4)',3X,'LCOV(5)',3X,'LCOV(6)',3X,'LCOV(7)',3X,'LCOV(8)',3X,'LCOV
     *(9)'/7(2X,I6,2X)////)
  110 DO 120 J=1,143
  120 JDAT(J)=IDAT(J)
      IF (LASTCK .EQ. 0 .AND. TASK .EQ. 2) LASTCK=3
  130 CALL CFEXEC(TASK,TIME,JDAT,XO,YO,XLN,YLN,LAST,TYMOLD,OSP,DIST,TYMC
     *,TSSQ,NSSQ,NBKOUT,IDENT)
      LASTCK=TASK
      IF (MFP .LE. 0) GO TO 10
  140 TASK=5
      IF (LASTCK .EQ. 1) GO TO 160
      IF (SENSE SWITCH 1) 150,160
```

```
  150 WRITE (6,3000) LAST
 3000 FORMAT('1',10X,'NUMBER OF OBSERVATIONS INTERPRETED =',I4,
     •      /'      IX     IY     IZ   ITIME IORC ITYPE IVALU NTCLC  NCFIL
     • NVV  MINRAD MAXTOP MSPWE  LAY1 LAY2 LAY3 LAY4 LAY5 LAY6 LAY7 LAY8
     • LAY9')
      DO 155 JMO=1,LAST
      IF (MOD(JMO,50) .EQ. 0) WRITE (6,3000)
      CALL BLKIN(NOBWDT,JDAT,JMO,KFINO,ISTAT)
  155 WRITE (6,3010) (JDAT(LJM),LJM=1,22)
 3010 FORMAT(3X,I5,1X,I5,1X,I5,2X,I4,1X,I4,2X,I3,3X,I2,2X,5(I6,1X),1X,9(
     •I4,1X))
  160 CONTINUE
      CALL CFEXEC(TASK,TIME,JDAT,XO,YO,XLN,YLN,LAST,TYMOLD,DSP,DIST,TYMC
     •,ISSQ,NSSQ,NBKOUT,IDENT)
      GO TO 5
  200 READ (5,1000) NBKOUT $ INPUT LAST RECORD NUMBER ON CFDB
      WRITE (6,2049) NBKOUT
 2049 FORMAT (1X,'NBKOUT = ',I5)
      READ (5,1000) TIME,TYMOLD
      WRITE (6,2100) TIME,TYMOLD,NSSQ,(ISSQ(I),I=1,NSSQ)
 2100 FORMAT(/3X,'TIME',5X,'TYMOLD',5X,'NSSQ',4X,'ISSQ(1)',3X,'ISSQ(2)',
     •3X,'ISSQ(3)',3X,'ISSQ(4)'/8(2X,I6,2X)//)
      WRITE (6,2110) DSP,(DIST(I),I=1,3),(TYMC(I),I=1,3)
 2110 FORMAT(/5X,'DSP',8X,'DIST(1)',5X,'DIST(2)',5X,'DIST(3)',5X,'TYMC(1
     •)',5X,'TYMC(2)',5X,'TYMC(3)'/7(2X,F8.1,2X)/)
      IF(TASK .EQ. 3) GO TO 250
      READ  (5,1020) XO,YO,XLN,YLN
 1020 FORMAT(8F10.1)
      WRITE (6,2120) XO,YO,XLN,YLN
 2120 FORMAT(/5X,'XO',10X,'YO',9X,'XLN',9X,'YLN'/4(2X,F8.1,2X))
  250 NBKOUT=NBKOUT+1
      IF (LASTSK .EQ. 0) LASTSK = 3
      READ(5,2130) IDENT
 2130 FORMAT(10A8)
      CALL CFEXEC(TASK,TIME,JDAT,XO,YO,XLN,YLN,LAST,TYMOLD,DSP,DIST,TYMC
     •,ISSQ,NSSQ,NBKOUT,IDENT)
      LASTSK=TASK
      IF (NPRT .EQ. 0) GOTO 5
      NWDBLK=ICFDB
      CALL BLKIN(NWDBLK,CFRD,NBKOUT,NOFF,ISTAT)
      WRITE (6,2170) NBKOUT
```

```
2130 FORMAT('1',9X,'CONTENTS OF BLOCK NO.',I3,' OF THE CFDR FILE'///)
     WRITE (6,2140) (CFASD(I),I=1,10)
2140 FORMAT(4X,'IDENT= ',10A6//4X,'GRID POINT DATA FOLLOWS'/)
     LYNC=10
 260 WRITE (6,2150)
2150 FORMAT(2X,'I',4X,'J',4X,'SKYC',4X,'CETL',4X,'VIS',5X,'BASE',4X,'TO
    *P',5X,'WETHR',3X,'LAY1',4X,'LAY2',4X,'LAY3',4X,'LAY4',4X,'LAY5',4X
    *,'LAY6',4X,'LAY7',4X,'LAY8',4X,'LAY9'/)
     DO 280 I=IBEG,IEND
     DO 280 J=JBEG,JEND
     LYNC=LYNC+1
     IF(LYNC .LT. 54) GO TO 270
     LYNC=3
     WRITE (6,2160)
2160 FORMAT('1')
     WRITE (6,2150)
 270 WRITE (6,2170) I,J,(GRDPV(I,J,M),M=1,15)
2170 FORMAT(1X,I2,3X,I2,4X,I3,4X,I6,2X,I6,2X,I6,2X,I6,4X,I2,3X,9(1X,I6,
    *1X))
 280 CONTINUE
     GO TO 5
     END
```

```
CFAD*CFADD(1).CFMAP
      SUBROUTINE CFMAP(IBEG,IEND,JBEG,JEND,DIST,TYMC,ISSQ,NSSQ,MNBR,
     *MTIME,NOB)

C     THIS ROUTINE USES THE BEST REPORTS GENERATED BY COMBER TODETER-
C     MINE THE CFDB PARAMETERS AT SPECIFIED GRID POINTS IN THE WINDOW.

C     INPUT DATA

C     IBEG = I INDEX OF LEFT HAND EDGE OF WINDOW OR SUB-WINDOW.
C     IEND = I INDEX OF RIGHT HAND EDGE OF WINDOW OR SUB-WINDOW.
C     JBEG = J INDEX OF BOTTOM EDGE OF WINDOW OR SUB-WINDOW.
C     JEND = J INDEX OF TOP EDGE OF WINDOW OR SUB-WINDOW.
C     DIST = DISTANCE CONSTANTS IN WEIGHTING FUNCTION, KM.
C     TYMC = TIME CONSTANTS IN WEIGHTING FUNCTION, MINUTES.
C     ISSQ = SEARCH SQUARE SIZES, NO. OF GRID POINTS.
C     NSSQ = NUMBER OF SEARCH SQUARES.
C     MNBR = MINIMUM NUMBER OF BEST REPORTS REQUIRED TO CALCULATE CFDB
C            PARAMETERS AT A GRID POINT.
C     MTIME = MAP TIME (0 - 1440).
C     NOB = NUMBER OF OBS/REP.

      INTEGER CRDPV,GRD


      COMMON /INTOBS/ INOBS(23,100)
      COMMON /CFDB/ NOUSZ(10),CRDPV(25,20,15)

      DIMENSION JPT(100),ISSQ(5),DIST(3),TYMC(3),KNPT(300),NPT(100)

      DATA MISS /-32768/
      DATA GRD/25/,LNTHX/500/,LNTHY/500/,NOBR/100/,MNP/300/

      IP=LNTHX/GRD
      JP=LNTHY/GRD


C     STEP THROUGH THE CFDB PARAMETERS
      DO 220 M=8,22
      MST=M-7
      IF(MST .GT. 7) MST=7
```

```
C     SEARCH BEST REPORT OBS/REP AND GENERATE A POINTER TABLE TO THOSE
C     REPORTS HAVING INFORMATION ON THE CFOR PARAMETER BEING ANALYZED.

      NUM=0
      DO 20 N=1,NOP
      IF(INOBS(M,N) .EQ. MISS) GO TO 20
      NUM=NUM+1
      JPT(NUM)=N
   20 CONTINUE

C     STEP THROUGH GRID POINTS.

      DO 210 I=IBEG,IEND
      IXD=GRD*(I-1)*10
      DO 210 J=JBEG,JEND
      IYD=GRD*(J-1)*10
      NFD=0

      DO 23 NJ=1,NUM
   23 NPT(NJ)=JPT(NJ)
      NMPT=NUM

C     STEP THROUGH SEARCH SQUARES OF INCREASING SIZE.

      NSQ=1
   25 IF(NMPT .LE. 0) GO TO 85
      JSD=GRD*ISQ(NSQ)*10
      N=1
   30 NN=NPT(N)
      NXD=INOBS(1,NN)
      NYD=INOBS(2,NN)
      IXDF=IABS(IXD-NXD)
      IYDF=IABS(IYD-NYD)
      IF((IXDF .GT. JSD) .OR. (IYDF .GT. JSD)) GO TO 50
      NFD=NFD+1
      KNPT(NFD)=NN
      IF(N .EQ. NMPT) GO TO 60
      NMPT=NMPT-1
      DO 40 NP=N,NMPT
   40 NPT(NP)=NPT(NP+1)
```

```
      GO TO 30
   50 N=N+1
      IF(N-NMPI) 30,30,70

C     JUMP TO 90 IF THE MINIMUM NUMBER OF BEST REPORTS USEABLE AT THE
C     GRID POINT HAS BEEN FOUND.

   60 NMPI=NMPI-1
   70 IF(NFD .GE. MNBR) GO TO 90
      NSQ=NSQ+1

C     JUMP TO 80 IF THE LARGEST SEARCH SQUARE HAS BEEN EXCEEDED.

      IF(NSQ-NSSQ) 25,25,80

C     JUMP TO 90 IF AT LEAST ONE BEST REPORT LYING WITHIN THE LARGEST
C     SEARCH SQUARE HAS BEEN FOUND.

   80 IF(NFD .GT. 0) GO TO 90
   85 MP=M-7
      GRDPV(I,J,MP)=MISS
      GO TO 210
   90 ITG=0
      SMWF=0.
      SMWFO=0.
      DO 180 N=1,NFD
      NB=KNPT(N)
      DXS=(IXO-INOBS(1,NB))**2
      DYS=(IYO-INOBS(2,NB))**2
      DIS=SQRT(DXS+DYS)
      TD=MTIME-INOBS(4,NB)
      IF(TD .LT. 0) TD=1440+TD
      IF(INOBS(23,NB) .EQ. MISS) GO TO 100
      LT=IABS(INOBS(23,NB))
      LT=MOD(LT,10)
      IF(LT .GT. 3) LT=3
      TC=TYMC(LT)
      RC=RIST(LT)*10.
      GO TO 110
  100 TC=TYMC(3)
```

```
      DC=DIST(3)*10.
  110 WF=INOBS(7,NB)*EXP(-((DIS/DC)**2)-((IT/TC)**2))
      GO TO (140,120,130,140,140,150,130),MST
  120 IF(INOBS(M,NB) .LT. 0) IIC=IIC+1
      LGD=IABS(INOBS(M,NB))
      IF(M .NE. 9) GO TO 160
      LGD=LGD/10
      GO TO 160
  130 LGD=MOD(INOBS(M,NB),5)
      IF(LGD .EQ. 1) IIC=IIC+1
      LGD=INOBS(M,NB)-LGD
      GO TO 160
  140 LGD=INOBS(M,NB)
      GO TO 160
  150 IF(WF .LT. SMWFO) GO TO 180
      SMWFO=WF
      IGPV=INOBS(13,NB)
      GO TO 180
  160 OBS=LGD
      SMWF=SMWF+WF
      SMWFO=SMWFO+(WF*OBS)
  180 CONTINUE
      IF (M .EQ. 13) GO TO 182
      IF (SMWF - 1.0E-18) 183,184,184
  182 IF (SMWFO .GT. 1.0E-18) GO TO 200
      IGPV=0
      GO TO 200
  183 IGPV=MISS
      GO TO 200
  184 CONTINUE
      XIIC=IIC
      XNFD=NFD
      FRAC=XIIC/XNFD
      GPV=SMWFO/SMWF
      GO TO (195,190,190,195,195,200,185),MST
  185 GPV=GPV+2.5
      IGPV=GPV/5
      IGPV=IGPV*5
      IF(IGPV .EQ. 0) GO TO 200
      IF(FRAC .LT. .5) GO TO 200
```

```
      IGPV=IGPV+1
      GO TO 200
  190 IF(FRAC .GE. .5) GPV=-GPV
  195 IGPV=GPV+.5
  200 MOZ=M-7
      PROFV(I,J,MOZ)=IGPV
  210 CONTINUE
  220 CONTINUE
      RETURN
      END
```

CFAF*CFARS(1).COMOBR

```
      SUBROUTINE COMOBR(NOB,DSP,TIME,LDFILE)
C     RANKS, RESOLVES CONFLICTING INFORMATION, AND COMBINES CFDP ELE-
C     MENTS OF PROXIMATE OBS/REPS; THEN INSURES INTERNAL CONSISTENCY OF
C     COMBINED OBS/REP

      INTEGER GRD,GREL,TIME

      COMMON /MAP/XREF,YREF,CMRD,LNTHX,LNTHY,GRD
      COMMON /INTOBR/INOBS(23,100)

      DIMENSION GREL(24,10),MTEMP(24),NREC(11),DS(11)

      DATA NWDBLK/23/
      DATA MISS/-32768/
      DATA NOBR/100/

      DSPH=DSP*10.
      NBKOUT=0
      DO 300 N=1,NOB
      ICT=1
      DO 20 M=1,23
   20 GREL(M,ICT)=INOBS(M,N)
      GREL(24,ICT)=1

C     COLLECT THE CLOSEST 10 OR LESS OBS/REP TO THE SITE OF OBS/REP NO.
C     INOBS(5,N), CALLED THE BEST REPORT SITE, WHICH ARE NO MORE THAN
C     'DSP' KM. FROM THE BEST REPORT SITE.

      DO 35 NN=1,NOB
      IF(NN .EQ. N) GO TO 35
      DXS=(INOBS(1,N)-INOBS(1,NN))**2
      DYS=(INOBS(2,N)-INOBS(2,NN))**2
      DIST=SQRT(DXS+DYS)
      IF(DIST .GT. DSPH) GO TO 35
      ICT=ICT+1
      NREC(ICT)=NN
      DS(ICT)=DIST
      IF(ICT .LE. 2) GO TO 35
      JX=ICT
   32 IF(DS(JX) .GE. DS(JX-1)) GO TO 30
```

```
      DTM=DS(JX-1)
      NTM=NREC(JX-1)
      DS(JX-1)=DS(JX)
      NREC(JX-1)=NREC(JX)
      DS(JX)=DTM
      NREC(JX)=NTM
      JX=JX-1
      IF(JX .GT. 0) GO TO 35
   30 IF(ICT .GT. 11) ICT=11
   35 CONTINUE

C     JUMP TO 40 IF OTHER OBS/REP ARE WITHIN DSP KM. OF BEST REPORT SITE

      IF(ICT .GT. 1) GO TO 40
      DO 38 M=1,23
   38 MTEMP(M)=OPEL(M,ICT)
      GO TO 290
   40 DO 45 IC=2,ICT

      NX=NREC(IC)
      DO 43 M=1,23
   43 OPEL(M,IC)=INOBS(M,NX)
      OPEL(24,IC)=IC
   45 CONTINUE
   50 DO 90 NR=2,ICT
      NRR=NR

C     RANK OBS/REP ON BASIS OF TIME OF RECEIPT

   55 ITD1=TIME-OPEL(4,NRR-1)
      IF (ITD1 .LT. 0) ITD1=ITD1+1440
      ITD2=TIME-OPEL(4,NRR)
      IF (ITD2 .LT. 0) ITD2=ITD2+1440
      IF (ITD2 - ITD1) 90,60,80

C     RANK OBS/REP ON BASIS OF TYPE AS FOLLOWS:
C          RANK           TYPE
C           1             AIRWAYS
C           2             METAR
C           3             SYNOP
C           4             RAOB
```

```
C             5           AFOWC-30NERH

      60 JTP1=IABS(GPEL(6,NRR-1))
         JTP2=IABS(GPEL(6,NRR))
         IF (JTP2 -JTP1) 80,65,90
C        RANK ON BASIS OF VALUE OF OBS/REP.
      65 IF (GPEL(7,NRR-1) - GPEL(7,NRR)) 80,70,90
C        RANK OBS/REP ON THE BASIS OF URGENCY.
      70 ISYN1=2
         IF (GPEL(6,NRR-1) .LT. 0) ISYN1=1
         ISYN2=2
         IF (GPEL(6,NRR) .LT. 0) ISYN2=1
         IF (ISYN2 - ISYN1) 80,75,90

C        RANK ON DISTANCE FROM BEST REPORT SITE.

      75 IF(GPEL(24,NRR-1) .LE. GPEL(24,NRR)) GO TO 90
      80 DO 85 MI=1,24
         MTEMP(MI)=GPEL(MI,NRR-1)
         GPEL(MI,NRR-1)=GPEL(MI,NRR)
      85 GPEL(MI,NRR)=MTEMP(MI)
         NRR=NRR-1
         IF(NRR .GE. 2) GO TO 55
      90 CONTINUE

C        CREATE A BEST REPORT AT THE SITE OF OBS/REP NO. INOBS(5,N).
C        ASSIGN THE LOCATION, STATION ELEVATION, TIME SEQUENCE NO. AND
C        TYPE OF OBS/REP NO. INOBS(5,N) TO THIS BEST REPORT.

         DO 100 M=1,5
     100 MTEMP(M)=INOBS(M,N)

C        INITIALLY ASSIGN THE GFOS PARAMETERS OF THE LOWEST RANKING OBS/REP
C        WITHIN DSR KM. OF THE BEST REPORT SITE TO THE BEST REPORT.

         KLI=10
         MVAL=GPEL(7,IST)

         DO 120 M=8,23
         MTEMP(M)=GPEL(M,IST)
```

```
C     JUMP TO 130 FOR ALL CFDB PARAMETERS EXCEPT THE CEILING

      IF(M .NE. 9) GO TO 130

C     DETERMINE THE CODE NO. INDICATING THE METHOD BY WHICH THE CEILING
C     WAS MEASURED.

      KL1=IABS(OPEL(9,ICT))
      KL1=MOD(KL1,10)

C     STEP UPWARD THROUGH RANKED OBS/REP AND REPLACE CFDB PARAMETERS
C     PREVIOUSLY ASSIGNED TO BEST REPORT BY CORRESPONDING PARAMETERS IN
C     OBS/REP OF HIGHER RANK LOCATED WITHIN DSR KM. OF BEST REPORT SITE.
C     DO NOT MAKE THE REPLACEMENT IF THE CFDB PARAMETER IN THE HIGHER
C     RANKING OBS/REP IS MISSING.

  130 DO 170 I=2,ICT
      IPV=ICT+1-I
      IF(OPEL(M,IPV) .EQ. MISS) GO TO 170

C     JUMP TO 150 FOR ALL PARAMETERS EXCEPT CEILING

      IF(M .NE. 9) GO TO 150
      KL2=IABS(OPEL(M,IPV))
      KL2=MOD(KL2,10)

C     DO NOT REPLACE CEILING UNLESS METHOD OF CEILING DETERMINATION IN
C     HIGHER RANKING OBS/REP IS ALSO A HIGHER RANKING METHOD THAN WAS
C     USED IN DETERMINING THE CEILING VALUE PRESENTLY ASSIGNED TO THE
C     BEST REPORT.

      IF(KL1 .LE. KL2) GO TO 170
      KL1=KL2
  150 MTEMP(M)=OPEL(M,IPV)
  170 CONTINUE

C     INSURE THAT TOTAL SKY COVER IS NOT LESS THAN THE PERCENT CLOUD
C     COVER IN ANY LAYER.

      DO 220 M=14,20
```

```
  220 MTEMP(3)=MAX0(MTEMP(3),MTEMP(M))

C       INSURE MINBAR LESS THAN MAXTOP

        IF(MTEMP(12) .LE. MTEMP(11)) MTEMP(12)=MISS
        DO 230 I=2,ICT
        IRV=ICT+1-I
        IF((IABS(OPEL(5,IRV)) .GT. 7) .OR. (OPEL(23,IRV) .EQ. MISS)) GO TO
     * 230
        MTEMP(23)=OPEL(23,IRV)
  230 MVAL=MVAL+OPEL(7,IRV)
        MVAL=MVAL/ICT
        MTEMP(7)=((2*INOBS(7,N))+MVAL)/3
  290 NBKOUT=NBKOUT+1
        CALL BLKOUT(NWDBLK,MTEMP,NBKOUT,LSFILT,ISTAT)
  300 CONTINUE

  310 DO 330 N=1,NBKOUT
        CALL BLKIN(NWDBLK,MTEMP,N,LSFILT,ISTAT)
        DO 320 M=1,23
  320 INOBS(M,N)=MTEMP(M)
  330 CONTINUE
        RETURN
        END
```

```
CFAS*CFASE(1).EXEC1
      SUBROUTINE EXEC1(TASK,TIME,OBSRPT,F1,LAST,TYMOLD,F2,I1,NORR)
C
C     INPUT DATA (FORMAL PARAMETERS)

C     TASK = TASK REQUESTED BY FRAMO
C              1 = SET UP THE OBS/REP STORAGE FILES
C              2 = INPUT OBS/REP
C              3 = CREATE A NEW CFDB
C              4 = UPDATE THE LATEST CFDR ON FILE
C              5 = OUTPUT UPDATED COMMON BLOCK BASE TO MASS STORAGE
C     TIME = REFERENCE TIME OF CFDR CREATION OR UPDATE
C     OBSRPT = OBS/REP
C     LAST = SEQUENCE NUMBER OF THE LAST OBS/REP STORED.
C     TYMOLD = TIME OF OLDEST OBS/REP TO BE USED IN A CREATION OR UPDATE

C     DATA STATEMENTS
C
C     LFFILE = LOGICAL DEVICE NO. OF TEMPORARY STORAGE FILE USED IN
C              'COMOBR'.
C     NORR = MAXIMUM NUMBER OF OBS/REP THAT CAN BE USED IN A CREATION
C            OR UPDATE.

C     OBS/REP INPUT ELEMENTS

C     IX = X DISTANCE OF OBS/REP SITE FROM IXREF, HECTOMETERS.
C     IY = Y DISTANCE OF OBS/REP SITE FROM IYREF, HECTOMETERS.
C     IZ = OBS/REP SITE ELEVATION ABOVE MEAN SEA LEVEL, METERS.
C     ITIME = TIME OF OBS/REP (0-1440)
C     ITYPE = TYPE OF OBS/REP
C                1 = AIRWAYS, -1 IF A SPECIAL.
C                2 = METAR, -2 IF A SPECIAL (SPECI)
C                3 = SYNOP
C                4 = UPPER AIR (RAOB), -4 IF A SPECIAL
C                5 = AFGWC 3D-NEPH OUTPUT
C     FOR EXPLANATION OF REMAINING OBS/REP INPUT ELEMENTS CONSULT
C     LISTINGS OF SUBROUTINE SFPINT IF A SURFACE OBS/REP OR
C     SUBROUTINE UAPINT IF AN UPPER AIR OBS/REP.

C     CFDR PARAMETERS DETERMINED FROM OBS/REP.
```

```
C     IOBS = SEQUENCE NO. OF OBS/REP.
C     IVALU = CFDB INFORMATION VALUE OF THE OBS/REP
C     NTCLD = TOTAL CLOUD COVER, (00 TO 100)
C     NCEIL = HEIGHT OF CEILING LAYER (AGL), DEKAMETERS. MINUS IF A
C             VARIABLE CEILING. LAST DIGIT OF NCEIL INDICATES THE
C             METHOD BY WHICH THE CEILING WAS DETERMINED.
C                   1 = MEASURED
C                   2 = AIRCRAFT
C                   3 = BALLOON
C                   4 = RADAR
C                   5 = ESTIMATED
C                   6 = INDEFINITE
C     NVV = PREVAILING SURFACE VISIBILITY, METERS. MINUS IF VARIABLE.
C     MINBAS = HEIGHT OF BASE OF LOWEST CLOUD, DEKAMETERS.
C     MAXTOP = HEIGHT OF TOP OF HIGHEST CLOUD THAT COULD BE DETERMINED
C              FROM OBS/REP ELEMENTS, DEKAMETERS.
C     MORWE = MOST SIGNIFICANT PRESENT WEATHER ELEMENT. (WMO CODE 4677)
C     LCOV(I) = PERCENT CLOUD COVER IN THE CFDB LAYERS, (00 TO 100).
C
C                              CFDB LAYERS
C                 LAYER         BOTTOM                       TOP
C                   1        0 FEET       0 METERS    150 FEET      45 METERS
C                   2      150           45           300           91
C                   3      300           91           600          183
C                   4      600          183          1000          305
C                   5     1000          305          2000          610
C                   6     2000          610          3500         1067
C                   7     3500         1067          5000         1524
C                   8     5000         1524          6500         1981
C                   9     6500         1981         10000         3048


      INTEGER TASK,TIME,OBSRPT,TYMOLD

      COMMON /CLOCKT/NOWTYM,LASTSK
      COMMON /OBSREP/IX,IY,IZ,ITIME,IOBS,ITYPE,IVALU,NTCLD,NCEIL,NVV,
     *MINBAS,MAXTOP,MORWE,LCOV(9),ICL,ITCC,ICM,ICH,ICIC(10),NWEA(7),IPW,
     *NOUTE(33)
      DIMENSION OBSRPT(142),IVOBEL(44),KOBR(142), FI(4),FD(7),II(17)
      INCLUDE BASE.LIST
```

```
      EQUIVALENCE (KOBR(1),IX)

      DATA LSFILE/3/,NOBR/100/
      DATA KNUMBR /0/
      DATA IPRT/6/
      DATA NOBWRT/22/,KFINO/5/
      DATA MISS/-32768/

      GO TO (2,2,70,70,125),TASK
    2 IF (LASTSK .LE. 2) GO TO 5

C     RETRIEVE THE CONTENTS OF COMMON /BASE/ FROM MASS STORAGE.

      CALL BLKIN(KWORDS,DXSECT,1,KNUMBR,KSTATI)
      WRITE (6,3000) NINI,IBLOCK,NBJNOW,INUMBR,ISTATI,ISTATO,JNUMBR,JSTA
     *TI,JSTATO,JTIME,LASTJ

    5 CONTINUE
      GO TO (10,20,70,70),TASK
C
C     COME HERE TO INITIALIZE AND SET UP OBS/REP STORAGE FILES
C
   10 CALL BEGIN
      IOBC=0
      RETURN
C
C     COME HERE TO INTERPRET AND FILE AN OBS/REP.
C
   20 DO 25 K=1,143
   25 KOBR(K)=OBSRPT(K)
      IOBC=LAST+1
      NTR=IABS(ITYPE)
      GO TO (30,30,30,40,50),NTR
C
C     COME HERE TO INTERPRET A SURFACE OBS/REP
C
   30 CALL SFDINT

      GO TO 60
C
C     COME HERE TO INTERPRET AN UPPER AIR OBS/REP.
```

```
C
   40 CALL UADINT
      GO TO 60
C
C     COME HERE TO PROCESS CLOUD-FOG DATA FROM THE AFGWC 3D-NEPH OUTPUT
C
   50 CALL AFDINT
   60 DO 65 K=1,44
   65 OBSRPT(K)=KOBR(K)
      IF (SENSE SWITCH 1) 67,68
   67 CALL BLKOUT(NOBWRT,OBSRPT,IOBC,KFIND,ISTAT)
   68 CONTINUE
      CALL STOREC(OBSRPT)
      LAST=IOBC
      IF(LAST .EQ. NOBR) LAST=0
      RETURN
   70 NOB=0
      IF(LASTSK .LE. 2) GO TO 80

C     RETRIEVE THE CONTENTS OF COMMON /BASE/ FROM MASS STORAGE.

      CALL BLKIN(KWORDS,DXSECT,1,KNUMBR,KSTATI)
      WRITE (6,3000) NINI,IBLOCK,NBJNOW,INUMBR,ISTATI,ISTATO,JNUMBR,JSTA
     *TI,JSTATO,JTIME,LASTJ

   80 INCODE=1
C
C     INSURE THAT TYMOLD IS NOT MORE THAN 1080 MINUTES (18 HOURS) PRIOR
C        TO TIME. RESET TYMOLD TO TIME-1080 IF NECESSARY.
C
      IDIF=ITYMDF(TIME,TYMOLD)
      IF(IDIF .GT. 0) GO TO 90

C     RETURN IF TYMOLD IS MORE THAN 24 HOURS PRIOR TO TIME

      WRITE(IPRT,1990) TYMOLD, TIME
 1990 FORMAT(' TYMOLD,',I5,' IS EITHER MORE THAN 24 HOURS PRIOR TO TIME,
     *',I5,' OR IS MORE RECENT THAN TIME.'/' TASK CANNOT BE COMPLETED WI
     *TH THIS AMBIGUITY.'//)
   90 IF(IDIF .LE. 1080) GO TO 100
```

```
      TYMOLD=TIME-1080
      IF(TYMOLD .LT. 0) TYMOLD=1440+TYMOLD
C
      WRITE(IPRT,2000) IDIF,TYMOLD
 2000 FORMAT(' TIME DIFFERENCE BETWEEN REFERENCE TIME AND TIME OF OLDEST
     * USEABLE OBS/REP = ',I3,' MINUTES'/' TIME OF OLDEST USEABLE OBS/RE
     *P RESET TO ',I4,' MINUTES WHICH IS 1080 MINUTES PRIOR TO REFERENCE
     *TIME'//)
C
C     RETREIVE OBS/REP IN REVERSE CHRONOLOGICAL ORDER FROM TIME TO
C          TYMOLD
C
  100 CALL RETOBR(INCODE,TIME,INOREL,NOMORE,TYMOLD)
      INCODE=2
C
C     JUMP TO 120 IF THERE ARE NO MORE OBS/REP IN THE DATA BASE.
C
      IF(NOMORE .EQ. 1) GO TO 120
      NOB=NOB+1
      CALL BLKOUT(23,INOREL,NOB,LSFILE,ISTAT)
C
C     JUMP BACK TO 100 AND ATTEMPT TO RETRIEVE ANOTHER OBS/REP IF THE
C     MAXIMUM USEABLE NUMBER HAS NOT BEEN REACHED.
C
      IF(NOB .LT. NOBR) GO TO 100
  120 CONTINUE
      IF(LASTSK .GE. 3) GO TO 130

C     STORE THE CONTENTS OF COMMON /BASE/ ON MASS STORAGE.

  125 CALL BLKOUT(KWORDS,BXSECT,1,KNUMBR,KSTATI)
      WRITE (6,3010) NINI,IBLOCK,NBJNOW,INUMBR,ISTATI,ISTATO,JNUMBR,JSTA
     *TI,JSTATO,JTIME,LASTJ

  130 RETURN
 3000 FORMAT(' CONTENTS OF COMMON /BASE/ HAS BEEN READ IN FROM MASS STOR
     *AGE- '/' NINI =',I7/' IBLOCK =',I7/' NBJNOW=',I7/' INUMBR =',I7/'
     *ISTATI =',I7/' ISTATO =',I7/' JNUMBR =',I7/' JSTATI =',I7/' JSTATO
     * =',I7/' JTIME =',I7/' LASTJ =',I7////)
 3010 FORMAT(' CONTENTS OF COMMON /BASE/ HAS BEEN OUTPUT TO MASS STORAGE
```

```
      *-'/' NINI =',I7/' IBLOCK =',I7/' NBJNOW =',I7/' INUMBR =',I7/' IST
      *ATI =',I7/' ISTATO =',I7/' JNUMBR =',I7/' JSTATI =',I7/' JSTATO ='
      *,I7/' JTIME =',I7/' LASTJ =',I7////)
       END

CFAS*CFASS(1).EXEC2
       SUBROUTINE EXEC2(TASK,TIME,OBSRPT,XO,YO,XLN,YLN,LAST,TYMOLD,DSP,
      *DIST,TYMC,ISSQ,NSSQ,NRKOUT,IDENT,NOB)
C
C
C      INPUT DATA (FORMAL PARAMETERS)
C
C      TASK = TASK REQUESTED BY FRAME
C              1 = SET UP THE OBS/REP STORAGE FILES
C              2 = INPUT OBS/REP
C              3 = CREATE A NEW CFDB
C              4 = UPDATE THE LATEST CFDB ON FILE
C      TIME = REFERENCE TIME OF CFDB CREATION OR UPDATE
C      OBSRPT = OBS/REP
C      XO = DISTANCE EAST FROM XREF OF THE LOWER LEFT HAND CORNER OF THE
C            SUB-WINDOW IN THE CFDB TO BE UPDATED, KM.
C      YO = DISTANCE NORTH FROM YREF OF THE LOWER LEFT HAND CORNER OF THE
C            SUB-WINDOW IN THE CFDB TO BE UPDATED, KM.
C      XLN = EAST-WEST LENGTH OF UPDATED SUB-WINDOW, KM.
C      YLN = NORTH-SOUTH LENGTH OF UPDATED SUB-WINDOW, KM.
C      LAST = SEQUENCE NUMBER OF THE LAST OBS/REP STORED.
C      TYMOLD = TIME OF OLDEST OBS/REP TO BE USED IN A CREATION OR UPDATE
C      DSP = MAXIMUM DISTANCE BETWEEN OBS/REP TO BE COMBINED INTO A
C             BEST REPORT, KM.
C      DIST = DISTANCE CONSTANTS IN WEIGHTING FUNCTION, KM.
C         DIST(1) USED WHEN CONVECTIVE CLOUDS ONLY PRESENT.
C         DIST(2) USED WHEN CONVECTIVE AND MIDDLE CLOUDS ONLY ARE
C                   PRESENT OR WHEN SHOWERY TYPE PRCIPITATION PRESENT OR
C                   PAST WEATHER.
C         DIST(3) USED FOR ALL OTHER CASES.
C      TYMC = TIME CONSTANTS IN WEIGHTING FUNCTION, MINUTES.
C         TYMC(1) USED WHEN CONVECTIVE CLOUDS ONLY PRESENT.
C         TYMC(2) USED WHEN CONVECTIVE AND MIDDLE CLOUDS ONLY ARE
C                   PRESENT OR WHEN SHOWERY TYPE PRCIPITIATION PRESENT OR
C                   PAST WEATHER.
C         TYMC(3) USED FOR ALL OTHER CASES.
```

```
C     ISSQ = SEARCH SQUARE SIZES, NO. OF GRID POINTS.
C     NSSQ = NO. OF SEARCH SQUARES USED IN ANALYSIS.
C     NBKOUT = BLOCK NO. IN THE CFDB FILE TO WHICH THE CREATION OR
C             UPDATE IS TO BE TRANSFERRED.
C     IDENT = TEN WORDS OF USER SUPPLIED IDENTIFICATION INFORMATION THAT
C             PRECEEDS THE CLOUD-FOG-WEATHER DATA ON THE FILE.

C     DATA STATEMENTS
C
C     LSFILE = LOGICAL DEVICE NO. OF TEMPORARY STORAGE FILE USED IN
C             'COMOBP'.
C     NCFF = LOGICAL SYSTEM FILE NO. OF THE CFDB FILE.
C     ILPP = DEVICE NO. OF LINE PRINTER
C     ICPP = LOGICAL DEVICE NO. OF CONSOLE PRINTER.
C     GRDPH = CFDB GRID POINT HEIGHT, METERS.
C     MNBR = MINIMUM NUMBER OF BEST REPORTS REQUIRED TO CALCULATE CFDB
C             PARAMETERS AT GRID POINT.
C     GRD = CFDB GRID. (GRID POINT SPACING, KM.)
C     LNTHX = EAST-WEST LENGTH OF THE CFDB WINDOW, KM.
C     LNTHY = NORTH-SOUTH LENGTH OF THE CFDB WINDOW, KM.
C     NOBR = MAXIMUM NUMBER OF OBS/REP THAT CAN BE USED IN A CREATION
C             OR UPDATE.

C     CFDB PARAMETERS DETERMINED FROM OBS/REP.

C     IOBS = SEQUENCE NO. OF OBS/REP.
C     IVALU = CFDB INFORMATION VALUE OF THE OBS/REP
C     NTCLC = TOTAL CLOUD COVER, (00 TO 100)
C     NCEIL = HEIGHT OF CEILING LAYER (AGL), DEKAMETERS. MINUS IF A
C             VARIABLE CEILING. LAST DIGIT OF NCEIL INDICATES THE
C             METHOD BY WHICH THE CEILING WAS DETERMINED.
C                   1 = MEASURED
C                   2 = AIRCRAFT
C                   3 = BALLOON
C                   4 = RADAR
C                   5 = ESTIMATED
C                   6 = INDEFINITE
C     NVV = PREVAILING SURFACE VISIBILITY, METERS. MINUS IF VARIABLE.
C     MINBAS = HEIGHT OF BASE OF LOWEST CLOUD, DEKAMETERS.
C     MAXTOP = HEIGHT OF TOP OF HIGHEST CLOUD THAT COULD BE DETERMINED
C             FROM OBS/REP ELEMENTS, DEKAMETERS.
```

```
C      MSPWE = MOST SIGNIFICANT PRESENT WEATHER ELEMENT. (WMO CODE 4677)
C      LCOV(I) = PERCENT CLOUD COVER IN THE CFOB LAYERS. (00 TO 100).
C                                    CFOB LAYERS
C                        LAYER         BOTTOM                    TOP
C                          1        0 FEET     0 METERS   150 FEET     45 METERS
C                          2      150          45         300          91
C                          3      300          91         600         183
C                          4      600         183        1000         305
C                          5     1000         305        2000         610
C                          6     2000         610        3500        1067
C                          7     3500        1067        5000        1524
C                          8     5000        1524        6500        1981
C                          9     6500        1981       10000        3046


      INTEGER TASK,TIME,OBSRPT,SKYCOV,CEILNG,CLDBAS,CLDTOP,WEATHR,VISIB,
     *GRD,GRDPH,GRDPV,TYMOLD,CFASD

      COMMON /MAP/ XREF,YREF,CMPD,LNX,LNY,GRDPS
       COMMON /INIOBR/INOBS(23,100)
      COMMON /CFOB/ JDENT(10),SKYCOV(20,20),CEILNG(20,20),VISIB(20,20),
     *CLDBAS(20,20),CLDTOP(20,20),WEATHR(20,20),LAYCOV(20,20,9)
      COMMON /CUTPT/IBEG,IEND,JBEG,JEND
      DIMENSION GRDPV(20,20,15),DIST(3),TYMO(3),ISSQ(5),LCOVA(9),
     *LCOVB(9),CFASD(6010),IDENT(10)
      INCLUDE GRDPTS.LIST

      EQUIVALENCE (CFASD(11),GRDPV(1,1,1),SKYCOV(1,1))

      DATA LSFILE/3/,NCFF/4/,NOBR/100/
      DATA MISS/-32768/
      DATA MNBR/1/
      DATA GRD/25/,LNTHX/500/,LNTHY/500/
      IP=LNTHX/GRD
      JP=LNTHY/GRD
      ICFOB=10+(IP*JP*15)
      IJP=IP*JP
      DO 70 I=1,NOR
   70  CALL BLKIN(23,INOBS(1,I),I,LSFILE,ISTAT)
      DO 80 K=1,10
   80 JDENT(K)=IDENT(K)
```

```
      WRITE (6,3000) NOB
      DO 90 I=1,NOB
      IF (MOD(I,50) .EQ. 0) WRITE (6,3000) NOB
      WRITE (6,3010) (INOBS(J,I),J=1,22)
   90 CONTINUE

C     DETERMINE THE LOWEST ALTITUDE IN THE LIST OF OBS/PER AND GRID
C     POINTS.

  120 IHREF=32000
      DO 130 N=1,NOB
  130 IHREF=MIN0(IHREF,INOBS(3,N))
      DO 140 I=1,IP
      DO 140 J=1,JP
  140 IHREF=MIN0(IHREF,GRAPH(I,J))
C
C     REFERENCE CEILING, MINIMUM BASE OF CLOUD, MAXIMUM TOP OF CLOUDS,
C     AND THE CFDB LAYERS TO THE REFERENCE ALTITUDE, IHREF.
C
      DO 190 N=1,NOB
      DO 160 M=9,13
      IF(INOBS(M,N) .EQ. MISS) GO TO 160
      MGT=M-8
      GO TO (145,160,150,150,160),MGT
  145 ISYN=2
      IF(INOBS(9,N) .LT. 0) ISYN=1
      MTMP=IABS(INOBS(9,N))
      MDS=MOD(MTMP,10)
      MTMP=MTMP/10
      INOBS(9,N)=((MTMP*10)+INOBS(3,N)-IHREF)/10
      IF(INOBS(9,N) .LT. 0) INOBS(9,N)=0
      INOBS(9,N)=((10*INOBS(9,N))+MDS)*((-1)**ISYN)
      GO TO 160
  150 INOBS(M,N)=((10*INOBS(M,N))+INOBS(3,N)-IHREF)/10
      IF(INOBS(M,N) .LT. 0) INOBS(M,N)=0
  160 CONTINUE
      DO 170 M=14,22
      MGT=M-13
      LCOVB(MGT)=INOBS(M,N)
  170 LCOVA(MGT)=MISS
      THB=INOBS(3,N)
```

```
      CALL MVLCOV(LCOVA,LCOVB,IHPEP,IHS)
      DO 180 M=14,22
      MGT=M-13
  180 INOBS(M,N)=LCOVA(MGT)
  190 CONTINUE

C     RANK OBS/REP WITHIN 'DSP' KM. OF A GIVEN OBS/REP. RESOLVE CONFLICT
C     ING INFORMATION IN THE SAME CFDB ELEMENTS OF THE SEVERAL OBS/REP
C     ON THE BASIS OF RANK AND COMBINE NON CONFLICTING INFORMATION INTO
C     A BEST OBS/REP AT THE SITE OF THE GIVEN OBSREP.

      CALL COMOBR(NOB,DSP,TIME,LSFILE)
      MGT=TASK-2
      GO TO(200,210),MGT
C
C     COME HERE TO CREATE A NEW CFDB
C
  200 IBEG=1

      IEND=IP
      JBEG=1
      JEND=JP
      GO TO 220

C     COME HERE TO UPDATE AN EXISTING CLOUD FOG DATA-BASE.

  210 IXO=XO
      IBEG=IXO/GRD +1
      IXO=XO+XLN
      IEND=IXO/GRD +1
      IXO=MOD(IXO,GRD)
      IF(IXO .GT. 0) IEND=IEND+1
      JYO=YO
      JBEG=JYO/GRD +1
      JYO=YO+YLN
      JEND=JYO/GRD +1
      JYO=MOD(JYO,GRD)
      IF(JYO .GT. 0) JEND=JEND+1
      IF(IEND .GT. IP) IEND=IP
      IF(JEND .GT. JP) JEND=JP
  220 CALL CFMAP(IBEG,IEND,JBEG,JEND,DIST,TYMC,ICCO,NSSO,MNBR,TIME,NOB)
```

```
C     REFERENCE CREATED OR UPDATED CFOB PARAMETERS TO GROUND LEVEL.

      DO 280 I=IBEG,IEND
      DO 280 J=JBEG,JEND
      DO 250 M=1,6
      IF(GRDPV(I,J,M) .EQ. MISS) GO TO 250
      GO TO (250,230,250,240,240,250),M
  230 ISYN=2
      IF(GRDPV(I,J,2) .LT. 0) ISYN=1
      MTMP=IABS(GRDPV(I,J,2))
      GRDPV(I,J,2)=((MTMP*10)+IHREF-GRDPH(I,J))/10
      IF(GRDPV(I,J,2) .LT. 0) GRDPV(I,J,2)=0
      GRDPV(I,J,2)=GRDPV(I,J,2)*((-1)**ISYN)
      GO TO 250
  240 GRDPV(I,J,M)=((GRDPV(I,J,M)*10)+IHREF-GRDPH(I,J))/10
      IF(GRDPV(I,J,M) .LT. 0) GRDPV(I,J,M)=0
  250 CONTINUE
      DO 260 M=7,15
      MY=M-6
      LCOVB(MY)=GRDPV(I,J,M)
  260 LCOVA(MY)=MISS
      IHA=GRDPH(I,J)
      CALL MVLCOV(LCOVA,LCOVB,IHA,IHREF)
      DO 270 M=7,15
      MY=M-6
      MTMP=MOD(LCOVA(MY),5)
      IF(MTMP .NE. 1) GO TO 270
      LCOVA(MY)=-(LCOVA(MY)-1)
  270 GRDPV(I,J,M)=LCOVA(MY)

C     INSURE MINBAS LESS THAN MAXTOP.

      IF(GRDPV(I,J,5) .LT. GRDPV(I,J,4)) GRDPV(I,J,5)=GRDPV(I,J,4)

C     INSURE THAT TOTAL SKY COVER NOT LESS THAN THE CLOUD COVER IN ANY
C     LAYER.

      DO 275 M=7,15
      IF(GRDPV(I,J,M) .EQ. MISS) GO TO 275
      MTMP=IABS(GRDPV(I,J,M))
      GRDPV(I,J,1)=MAX0(GRDPV(I,J,1),MTMP)
```

```
  233 CONTINUE
  240 CONTINUE
C
C     OUTPUT CREATED OR UPDATED PROC.
C
      NXBBLK=TOTBL
      CALL BLKOUT(NXBBLK,GRAPH,NBKOUT,NREC,TOTAL)
      RETURN
 1001 FORMAT('1',10X,'NUMBER OF OBSERVATIONS RETRIEVED FOR ANALYSIS =',
     * I6,  //'     IX    IY    IZ   ITIME IDRG ITYPE IVALU NCOLC  NCFIL
     * NWW  MINBAS MAXTOP NCORE  LAY1 LAY2 LAY3 LAY4 LAY5 LAY6 LAY7 LAY8
     * LAY9')
 1010 FORMAT(3X,I5,1X,I5,1X,I5,2X,I4,1X,I4,2X,I3,2X,I3,2X,9(I5,1X),1X,3I
     *4,1X))
      END

GRAF.GRAPH(1).GRPHINTAL
      GRAPHIC PROC
            DIMENSION GRAPH(20,20)
            DATA GRAPH/3*46,137,46,3*137,13*46,5*137,46,137,4*46,137,3*46,
          *3*137,46,4*137,46,3*137,7*46,137,3*46,7*137,46,3*137,13*46,3*137,
          *46,7*137,10*46,4*137,320,4*137,4*46,3*137,320,4*137,4*46,137,46,
          *137,320,137,320,137,2*320,137,3*320,3*137,5*46,3*137,11*320,137,
          *4*46,7*137,320,2*137,9*320,4*46,4*137,12*320,4*46,4*137,12*320,
          *4*46,5*137,11*320,3*46,137,3*320,137,13*320,2*137,46,137,16*320,
          *3*137,6*320,137,3*320,636,3*320,3*636,3*137,5*320,636,2*320,4*636,
          *4*137,5*320,2*636,4*320,4*636,4*137,7*320,636,4*320,4*636/
      END
```

```
CFAS*CFASS(0).SFDINT
      SUBROUTINE SFDINT
C
C     ROUTINE TO INTERPRET SURFACE OBS/REP IN TERMS OF CFCB PARAMETERS.
C
C     SOURCES OF INPUT DATA ARE AVIATION WEATHER REPORTS IN AIRWAYS AND
C       METAR CODES AND SURFACE SYNOPTIC REPORTS IN SYNOP CODE
C
C     INPUT DATA
C
C  IX = X DISTANCE OF OBS/REP SITE FROM IXREF, HECTOMETERS
C  IY = Y DISTANCE OF OBS/REP SITE FROM IYREF, HECTOMETERS
C  IZ = TERRAIN HEIGHT AT OBS/REP SITE, METERS
C  ITIME = TIME OF OBS/REP
C  ITYPE = TYPE OF OBS/REP
C                1=AIRWAYS   -1 IF A SPECIAL
C                2=METAR      -2 IF A SPECI (SPECIAL)
C                3=SYNOP
C  IDD = WIND DIRECTION, 0-360 FROM TRUE NORTH
C  IFF = WIND SPEED, METERS/SEC.
C  IPPP = SEA LEVEL PRESSURE, MILLIBARS
C  ITT = SURFACE TEMPERATURE, DEGREES KELVIN
C  ITD= SURFACE DEWPOINT, DEGREES KELVIN
C  ITSC = TOTAL SKY COVER, 0-9   WMO CODE 2700
C  IVIS = VISIBILITY-
C                 AIRWAYS - STATUTE MILES*100
C                 METAR - METERS
C                 SYNOP - WMO CODE 4377
C  NWEA(J) = PRESENT WEATHER-- FROM 1 TO 7 ELEMENTS MAY BE INPUT
C                 AIRWAYS - CFAS CODE 1
C                 METAR - WMO CODE 4679
C                 SYNOP - WMO CODE 4677
C  IPW = PAST WEATHER, 0-9  WMO CODE 4500
C  NH = SKY COVER DUE TO LOW OR MIDDLE CLOUDS, 0-9   WMO CODE 2700
C  ICL = LOW CLOUD TYPE, 0-9   WMO CODE 0513
C  IH = HEIGHT ABOVE GROUND OF LOWEST CLOUD, 0-9   WMO CODE 1600
C  ICM = MIDDLE CLOUD TYPE, 0-9   WMO CODE 0515
```

```
C  ICH = HIGH CLOUD TYPE, 0-9    WMO CODE 0509
C  NS(J) = SKY COVER DUE TO CLOUD LAYER - FROM 1 TO 10 LAYERS
C                    AIRWAYS - CFAS CODE 2
C                    METAR - WMO CODE 2700
C                    SYNOP - WMO CODE 2700
C  ICTS(J) = TYPE OF CLOUD IN LAYER, 0-9    WMO CODE 0500
C  IHS(J) = HEIGHT OF BASE OF CLOUD LAYER
C                    AIRWAYS - 100'S OF FEET
C                    METAR - WMO CODE 1677
C                    SYNOP - WMO CODE 1677
C  ITHN(J) = CLOUD LAYER THICKNESS INDICATOR
C                    1 IF THIN
C                    MISSING IF NOT THIN
C  ICLG = CEILING DESIGNATOR - FIRST TWO DIGITS ARE THE INDEX NO. J OF
C      THE CEILING LAYER.  THIRD DIGIT HAS A FOLLOWING MEANING
C                     1 = MEASURED
C                     2 = AIRCRAFT
C                     3 = BALLOON
C                     4 = RADAR
C                     5 = ESTIMATED
C                     6 = INDEFINITE
C  ICLGV = CHARACTERISTIC OF CEILING
C                     MISSING = NOT VARIABLE
C                     1 = VARIABLE
C  IVISC = VISIBILITY CHARACTERISTICS
C                    MISSING = NOT VARIABLE
C                    1 = VARIABLE
C
C  CLOUD/FOG DATA BASE PARAMETERS
C
C  IVALU = INFORMATION VALUE OF THE OBS/REP (1-10)
C            0 INDICATES NO DATA USEABLE FOR DETERMINING ANY CFDB PARAMS.
C            10 INDICATES AN OBS/REP WITH ALL NEEDED DATA PRESENT AND
C                 USEABLE.
C            1 TO 9 INDICATES AN OBS/REP WITH SOME MISSING OR NON-USEABLE
C                 DATA.
C  NTCLC = TOTAL CLOUD COVER. (00 - 100)
C  NCEIL = HEIGHT OF CEILING LAYER (AGL), DEKAMETERS + TYPE OF CEILING
```

```
C                    DIGIT AS PER THIRD DIGIT OF ICL9.  MINUS IF VARIABLE.
C  MINBAS = HEIGHT OF BASE OF LOWEST CLOUD (AGL), DEKAMETERS.
C  MAXTOP = HEIGHT OF THE TOP OF HIGHEST CLOUD (AGL), DEKAMETERS.
C  MSPWE = MOST SIGNIFICANT PRESENT WEATHER ELEMENT (WMO CODE 4677)
C  NVV = PREVAILING VISIBILITY AT SURFACE, METERS. NEGATIVE IF VARIABLE.
C  LCOV(9) = PERCENT CLOUD COVER IN THE CF03 LAYERS
C
C DERIVED LAYERED CLOUD INFORMATION
C
C  NUMLAY = NUMBER OF LAYERS GENERATED
C  KIND = KIND OF CLOUD LAYER
C                    1 = LOW
C                    2 = MIDDLE
C                    3 = HIGH
C                    4 = FOG
C                    5 = LOWEST CLOUD
C                    6 = CLEAR LAYER
C  ITHIN = THIN LAYER DESIGNATOR
C                    MISSING = NOT THIN
C                    1 = THIN
C  COVER = CLOUD COVER IN LAYER (0.0 - 1.0)
C  BASE = HEIGHT OF THE BASE OF LAYER, FEET.
C  TOP = HEIGHT OF TOP OF CLOUD LAYER, FEET.
C
C MAP AND WINDOW DATA
C
C  XREF=EAST-WEST UTM GRID COORDINATE OF LOWER LEFT HAND CORNER OF THE
C                    WINDOW, KM.
C  YREF= NORTH-SOUTH UTM GRID COORDINATE OF LOWER LEFT HAND CORNER OF
C                    THE WINDOW, KM.
C  CMRD = CENTRAL MERIDIAN OF WINDOW


      COMMON /OBSREP/ IX,IY,IZ,ITIME,IOBS,ITYPE,IVALU,NTCLC,NCEIL,NVV,
     *MINBAS,MAXTOP,MSPWE,LCOV(9),ICL,ITSC,ICM,ICH,ICTS(10),NWEA(7),IPW,
     *IDD,IFF,IPPP,ITT,ITD,IVIS,NH,IH,NC(10),IHC(10),ITHN(10),ICL9,ICL9V
     *,IVISC,NOUSE(58)
```

```
      COMMON/CLOUDS/NUMLAY,KIND(10),ITHIN(10),COVER(10),BASE(10),TOP(10)

      DATA MISS/-32768/,FMISS/-32768./

      COMMON/MAP/XREF,YREF,CMRD

      DIMENSION CODE(10)

      DATA CODE/82.,246.,492.,820.,1447.,2870.,4100.,5740.,7390.,-32768.
     */

C     TOPCLR=ASSUMED TOP OF ALL CLOUDS

      TOPCLR=40000.


C     INITIALIZE PARAMETERS

      VALU=0.
      MT=IABS(ITYPE)

C     JUMP TO 480 IF OBS/REP TYPE IS NOT AN AIRWAYS, METAR OR SYNOP.

      IF(MT .GT. 3) GO TO 480
      NUMLAY=0
      DO 10 I=1,10
      KIND(I)=MISS
      ITHIN(I)=MISS
      COVER(I)=FMISS
      BASE(I)=FMISS
   10 TOP(I)=FMISS
      NTCLC=MISS
      NCEIL=MISS
      MINBAS=MISS
      MAXTOP=MISS
      MOPWE=-1
      NVV=MISS
```

```
      DO 20 I=1,3
   20 LCOV(I)=MISS

C     CALCULATE LATITUDE OF OBS/REP.

      XUTM=IX
      XUTM=(XREF+XUTM/10.)/100.
      YUTM=IY
      YUTM=(YREF+YUTM/10.)/100.
      CALL BAKUTM(DLONG,DLAT,XUTM,YUTM,CMRD)

C     CONSTRUCT CLOUD LAYERS FROM LAYER CLOUD DATA IF PRESENT

      IF(NS(1) .GE. 0) CALL LAYCLD(DLAT,VALU)

C     CONVERT IH OF SYNOP CODE TO FEET

      IF(IH .GT. 8 .OR. IH .LT. 0) GO TO 110
      HITLOW=CODE(IH+1)
      GO TO 120
  110 HITLOW=FMISS

C     DETERMINE MOST SIGNIFICANT PRESENT WEATHER ELEMENT.

  120 DO 130 IW=1,7
      IF(NWEA(IW) .LT. 0) GO TO 128
      IF(NWEA(IW) .GT. 99 .AND. MI .NE. 1) GO TO 128
      MNWEA=MOD(NWEA(IW),100)
      MMSPW=MOD(MSPWE,100)
      IF(MNWEA-MMSPW) 126,122,124
  122 MSPWE=MAX0(NWEA(IW),MSPWE)
      GO TO 126
  124 MSPWE=NWEA(IW)
  126 NWEA(IW)=MNWEA
      GO TO 130
  128 NWEA(IW)=MISS
  130 MSPWE=MOD(MSPWE,100)
```

```
C     JUMP TO 165 IF VISIBILITY IS MISSING

          IF(IVIS .LT. 0) GO TO 165

C         CONVERT AIRWAYS AND SYNOP VISIBILITY CODES TO VISIBILITY IN METERS

          GO TO (140,150,150),MI

C         AIRWAYS CODE CONVERSION

      140 VIS=IVIS
          VIS=VIS*16.093
          IVIS=VIS
          GO TO 160

C         SYNOP CODE CONVERSION

      150 IF(IVIS .GT. 50) GO TO 152
          IVIS=IVIS*100
          GO TO 160
      152 IF(IVIS .GT. 80) GO TO 154
          IVIS=(IVIS-50)*1000
          GO TO 160
      154 IF(IVIS .LE. 89) GO TO 156
          IVIS=MISS
          GO TO 160
      156 IVIS=32760
      160 NVV=IVIS

C         MAKE NVV NEGATIVE IF VISIBILITY IS VARIABLE

          IF(IVISC .EQ. 1) NVV=-NVV

C         JUMP TO 170 IF THERE WAS NO LAYERED CLOUD DATA IN THE OBS/REP

      165 IF(NUMLAY .EQ. 0) GO TO 170

C         CHECK FOR FOG AND ESTIMATE PERCENTAGE CLOUD COVER AND TOPS OF
```

```
C         CLOUD LAYERS FROM HORIZONTAL VISIBILITY AND TYPE OF FOG

      CALL FOG(IVIS,NWEA,AMT,VALU)

C     JUMP IF LOWEST CLOUD HEIGHT IS MISSING

      IF(HITLOW .EQ. FMISS) GO TO 220

C     CODE A 1/16 CLOUD COVER

      NUMLAY=NUMLAY+1
      KIND(NUMLAY)=5
      COVER(NUMLAY)=0.0625
      BASE(NUMLAY)=HITLOW
      GO TO 225

C     CALCULATE TOTAL SKY COVER FROM CODE IF NOT MISSING

  170 IF(ITSC .LT. 0 .OR. ITSC .GT. 8) GO TO 180
      CTOT=ITSC/8.

C     ASSURE LOW-MIDDLE CLOUD COVER NOT GREATER THAN TOTAL SKY COVER
C     WHEN TOTAL SKY COVER NOT MISSING OR OBSCURED

      IF(NH .GT. ITSC .AND. NH .LE. 9) NH=ITSC
      GO TO 190
  180 CTOT=FMISS

C     JUMP IF LOWEST CLOUD AMOUNT PRESENT

  190 IF(NH .GE. 0 .AND. NH .LE. 3) GO TO 200
      CLOW=FMISS
      GO TO 210

C     TREAT OBSCURED LOWEST CLOUD AMOUNT AS OVERCAST

  200 IF(NH .EQ. 9) NH=8
```

```
      CLOW=NH/8.

C     CHECK FOR FOG AND ESTIMATE PERCENTAGE CLOUD COVER AND TOPS OF
C        CLOUD LAYERS FROM HORIZONTAL VISIBILITY AND TYPE OF FOG

  210 CALL FOG(IVIS,NWEA,AMT,VALU)

C     JUMP IF FOG COMPLETELY COVERS SKY

      IF(NUMLAY .GT. 0 .AND. AMT .GT. .33) GO TO 225

C     CONSTRUCT CLOUD LAYERS FROM MANDATORY SYNOP TYPE DATA

      IF(ICL .GT. 9) ICL=MISS
      IF(ICM .GT. 9) ICM=MISS
      IF(ICH .GT. 9) ICH=MISS
      CALL SYNOP(CTOT,CLOW,HITLOW,ICL,ICM,ICH,NWEA,DLAT,VAL,MSPWE)
      VALU=(VALU+VAL)/2.

C     IF NO LAYERED CLOUD INFORMATION OBTAINABLE FROM OBS/REP. JUMP TO
C         490

  220 IF(NUMLAY .EQ. 0) GO TO 490

C     JUMP IF LOWEST CLOUD BASE IS MISSING

  225 IF(HITLOW .LE. 0) GO TO 300

C     DETERMINE LOCATION OF THE LOWEST CLOUD

      DO 230 LNO=1,NUMLAY
      IF(KIND(LNO) .EQ. 5) GO TO 240
  230 CONTINUE
C     DETERMINE CLOUD COVER FOR LOWEST BASE.

  240 DO 260 LNX=1,NUMLAY
      IF(KIND(LNX) .EQ. 1) GO TO 250
```

```
      IF(KIND(LNX) .NE. 2) GO TO 260
  250 CLDINT=-0.0714285714 + 1.07142857*COVER(LNX)
      COVER(LNO)=AMAX1(CLDINT,0.0525)
      GO TO 300
  260 CONTINUE

C     DETERMINE CLOUD TOPS

  300 ELEV=IZ*3.2808

      CALL TOPS(ELEV,NWEA,DLAT)

C     LOWER THE HEIGHTS OF THE TOPS OF LAYERS DESIGNATED AS THIN

      DO 320 LNX=1,NUMLAY
      LTYP=KIND(LNX)
      GO TO (310,310,320,320,320,320),LTYP
  310 IF(ITHIN(LNX) .NE. 1) GO TO 320
      TOP(LNX)=BASE(LNX) + 0.5*(TOP(LNX)-BASE(LNX))
  320 CONTINUE

C     DETERMINE MINBAS AND MAXTOP OF CLOUDS
      BASINT=TOPCLR
      TOPINT=0.

      DO 340 LNX=1,NUMLAY
      LTYP=KIND(LNX)
      IF(LTYP .EQ. 6) GO TO 340
      IF(COVER(LNX) .GE. .025) GO TO 330
      COVER(LNX)=0.05
  330 BASINT=AMIN1(BASINT,BASE(LNX))
      TOPINT=AMAX1(TOPINT,TOP(LNX))
  340 CONTINUE
      MINBAS=BASINT*.03048 + .5
      MAXTOP=TOPINT*.03048 +.5

C     INSURE THAT THE MAXIMUM TOP OF CLOUDS IS AT LEAST EQUAL TO MINIMUM
C             BASE OF CLOUDS.
```

```
      IF (MAXTOP .LT. MINBAS) MAXTOP=MINBAS


C     DETERMINE PERCENT CLOUD COVER IN THE CFDB LAYERS AND IDENTIFY
C          LAYERS CONTAINING CLOUDS OBSERVED TO BE THIN

      DO 440 JM=1,4
      DO 430 LNX=1,NUMLAY
      LTYP=KIND(LNX)
      GO TO (360,370,380,390),JM
  360 IF(LTYP .EQ. 6) GO TO 400
      GO TO 430
  370 IF(LTYP .EQ. 5) GO TO 400
      GO TO 430
  380 IF(LTYP .EQ. 4) GO TO 400
      GO TO 430
  390 IF(LTYP .LE. 3) GO TO 400
      GO TO 430
  400 NTBASE=BASE(LNX)
      NTTOP=TOP(LNX)
C     CALCULATE PERCENT CLOUD COVER TO NEAREST 5 PERCENT

      NAMT=COVER(LNX)*100. + 2.5
      NAMT=IABS(NAMT-MOD(NAMT,5))
      IF(NAMT .EQ. 0 .AND. KIND(LNX) .NE. 6) GO TO 430

C     IF OBS/REP INDICATED A THIN CLOUD, CODE LAYER WITH A THIN DESIG.

      IF(ITHIN(LNX) .NE. 1) GO TO 410
      NAMT=NAMT+1

C     DETERMINE INDEX NOS. OF LOWEST AND HIGHEST CFDB LAYERS INFLUENCED
C         BY CLOUD LAYER NO. LNX

  410 CALL CFLAY(NTBASE,NTTOP,NIBASE,NITOP)
```

```
      IF(NTBASE .EQ. 0) GO TO 430

C     CODE THE AFFECTED CFDB LAYERS WITH THE PERCENT CLOUD COVER IN
C          CLOUD LAYER NO. LNX

      DO 420 LAY=NTBASE,NTTOP
  420 LCOV(LAY)=NAMT
  430 CONTINUE
  440 CONTINUE

      IF(ITSC .LT. 0 .OR. ITSC .GT. 9) GO TO 450

      IF(ITSC .EQ. 9) ITSC=8

      NTCLC=100.0*(AMT + (1.-AMT)*ITSC/8.0)+ 0.5
      GO TO 460

C     JUMP TO 460 IF NOT A SYNOP TYPE OBS/REP OR TOTAL SKY COVER WAS
C          NOT MISSING IF A SYNOP TYPE OBS/REP

  450 IF(MT .NE. 3) GO TO 460

C     REDUCE VALU TO 5. WHEN TOTAL SKY COVER IS MISSING

      IF(VALU .GT. 5.) VALU=5.

C     JUMP TO 480 IF NO CEILING LAYER

  460 IF(ICLG .LT. 0) GO TO 480
      LSC=ICLG/10
      CEILH=IHS(LSC)*100
      IF(MT .EQ. 1) GO TO 470
      IF(IHS(LSC) .LE. 50) GO TO 470
      CEILH=(IHS(LSC)-50)*1000
      IF(IHS(LSC) .LE. 80) GO TO 470
      CEILH=35000. - (13000./30.)*ABS(DLAT)
  470 NCEIL=CEILH*.03048
      NCEIL=10*NCEIL + MOD(ICLG,10)
```

```
      IF(ICLSV .EQ. 1) NCEIL=-NCEIL

  480 IVALU=VALU
      IF (MSPWE .EQ. -1) MSPWE=0
      RETURN
  490 IF(NVV .EQ. MISS) GO TO 500
      VALU=1.
  500 IF(MSPWE .EQ. -1) GO TO 480
      VALU=VALU+1.
      GO TO 480
      END
```

1PAGE

```
GRAF*GRAF(1).SHADE
C     SHADE - MAIN PROGRAM FOR DELINEATING AREAS OF DIFFERING VALUES OF
C             SKYCOVER, CEILING AND VISIBILITY BY DIFFERING SHADES OF
C             GRAY.

      INTEGER GRDPV

      DIMENSION PARAM(15),PVAL(9),LABEL(10),LXAB(14),LYAB(7),IJDENS(9)

      COMMON /GRDAT/GRDPV(20,20),KWEA(100)
      COMMON /ALPHA/PARAM

      DATA PARAM/'SKYCOV','CEILNG', 'VISIBL','CLDBAS','CLDTOP','WEATHR',
     *'LAY1CV','LAY2CV','LAY3CV','LAY4CV','LAY5CV','LAY6CV','LAY7CV',
     *'LAY8CV','LAY9CV'/
      DATA LXAB/6*6H       ,6HREL X ,6H(KM)   ,6*6H
      DATA LYAB/3*6H       ,6HREL Y ,6H(KM)   ,2*6H
      DATA NCHT/33/,NCHX/34/,NCHY/42/
      DATA KWEA/10*2,3*3,6,2*4,3*6,2*4,3*5,2*6,3,6,8*2,2*5,10*3,18*4,12*
     *5,20*0/
      XMIN=0.
      XMAX=500.
      YMIN=0.
      YMAX=500.
      KCHT=50
      READ  (5,1000) NBLOCK
      WRITE (6,1000) NBLOCK
   10 READ  (5,1000) IK,(IJDENS(I),I=1,IK)
      WRITE (6,1000) IK,(IJDENS(I),I=1,IK)
      READ  (5,1000) NPRM
      NOV=IK
      PVAL(1)=0.
 1000 FORMAT(8I10)
      IF (NPRM .NE. 6) GO TO 12
      NOV=5
      GO TO 15
   12 READ  (5,1010) (PVAL(I),I=2,NOV)
 1010 FORMAT(8F10.2)
   15 CALL GRDGIN(LABEL,NBLOCK,NPRM)
      WRITE (6,1000) NPRM,NOV
      IF (NPRM .EQ. 6) GO TO 16
```

```
      WRITE (6,1010) (PVAL(I),I=1,NOV)
   10 CALL CFPREP(NOV,PVAL,NPRM)
      CALL CNKMAP(XMIN,XMAX,YMIN,YMAX,NOV,LABEL,KCHT,LXAB,NCHX,LYAB,NCHY
     *,IJDENT,NPRM,PVAL)
      GO TO 10
      END
```